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## 94-T004

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# Analysis of Water Level Elevations and Discharge on the Lower Missouri River

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# Analysis of Water Level Elevations and Discharge on the Lower Missouri River

by
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for
Interagency Floodplain Management Review Committee
Scientific Assessment and Strategy Team
through
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# Preface

The Long Term Resource Monitoring Program (LTRMP) was authorized under the Water Resources Development Act of 1986 (Public Law 99-662) as an element of the U.S. Army Corps of Engineers' Environmental Management Program. The LTRMP is being implemented by the Environmental Management Technical Center, an office of the National Biological Survey, in cooperation with the five Upper Mississippi River System states, Illinois, Iowa, Minnesota, Missouri, and Wisconsin, with guidance and Program responsibility provided by the U.S. Army Corps of Engineers.

The mission of the LTRMP is to provide decisionmakers with information to maintain the Upper Mississippi River System as a viable large river ecosystem given its multiple-use character. The long-term goals of the Program are to understand the system, determine resource trends and impacts, develop management alternatives, manage information, and develop useful products.

The Scientific Assessment and Strategy Team (SAST) is responsible for providing scientific advice and assistance to Federal officials responsible for making decisions with respect to flood recovery in the Upper Mississippi and Missouri Basins. The team was tasked to provide information to support the decisionmaking process regarding both non-structural and structural approaches to river basin management. As part of this activity, the SAST required an analysis of water level elevations and discharge for four stations on the Missouri River. Preparation of the data and analyses were performed at the Environmental Management Technical Center (EMTC), National Biological Survey. All work, including publication of this report, was funded by the SAST.

This work is similar to other work being performed at the EMTC as part of the LTRMP, including Strategy 1.2.3, *Determine Effects of Water Levels and Discharges on the Upper Mississippi River Ecosystem,* and Strategy 3.1.2, *Predict Future Conditions Without Change in Management*, as specified in the Operating Plan of the LTRMP for the Upper Mississippi River System (USFWS 1992).

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# Introduction

Analysis of water level elevations (water levels) and discharge data on the Missouri River was required as part of the studies being performed by the Scientific Assessment and Strategy Team (SAST). The SAST is responsible for providing scientific advice and assistance to Federal officials responsible for making decisions with respect to flood recovery in the Upper Mississippi and Missouri Basins. The Team was tasked to provide information to support the decisionmaking process regarding both non-structural and structural approaches to river basin management.

Four stations that had both water level and discharge data were selected for the study: Hermann, Missouri, at river mile 97.9; Waverly, Missouri, at river mile 293.5; St, Joseph, Missouri, at river mile 448.2; and Omaha, Nebraska, at river mile 615.9. Data were originally collected by the U.S. Army Corps of Engineers (Corps) and the U.S. Geological Survey (USGS). Although data for one or the other variables were available for the period before 1928, data for both variables at all four stations were available starting in 1928. Analysis was performed at all four stations on data collected between 1928 and early 1994.

All four stations are downstream of, and are affected by, major impoundments on the Missouri River. Information on these impoundments is included in Table 1 and was obtained from the Corps, Missouri River Division Reservoir Control Center (1993).

# Methods

## *Discharge Data*

Discharge data were received for all four stations from the USGS in an electronic (ASCII) format. Data were reformatted on a DOS-based personal computer with each observation consisting of a station name, year, Julian day, and discharge in cubic feet per second (cfs). Data were then transferred to a Sun workstation and all analysis performed using the Statistical Analysis System (SAS; version 6.07). Additional information concerning the reformatting of data is included in the Procedures Manual for the Long Term Resource Monitoring Program (National Biological Survey 1994, draft).

## *Water Level Data*

Water level data for Omaha, Nebraska, were received as paper copies in tabular form from the USGS for years 1928 through 1984. Water level data for the other three stations were received as paper copies in tabular form from the Corps for years 1928 through approximately 1980. The rest of the data were received in an ASCII format. Data from paper copies were entered in electronic form using a Lotus spreadsheet program on a personal computer. Each record consisted of the year, Julian day, and the water level. Water levels were reported as either elevations above sea level or as stages in relation to a given datum. Original data that were not legible were left blank. All data were checked for accuracy by personnel not involved with data entry. Data were then transferred to a Sun workstation and all analysis performed using the SAS. Each of the four datasets had a station name added to each observation, and a gage zero datum added if the data were reported as stages. Table 2 lists the gage zero values for each station. These data were archived as the original data.

Water level and discharge data were then examined for possible outliers. Each year of data at each station was analyzed using a third-order polynomial regression of water levels against discharge. A plot of the two variables was made for all years if the R-squared value was <0.96. All discharge data appeared to be reasonable, but numerous water levels were questionable. Two additional datasets were created for water levels for the three downriver stations. The first group, designated as dataset "A," had outliers removed. An observation was considered an outlier if the elevation was ± 5 feet different from the values from the day before and day after, was not supported by an equivalent change in discharge, and had no notes on the original data sheet explaining why the data appeared to be anomalous. Numerous water levels that appeared to be outliers were left in the database because of ice problems when the data were taken.

The "A" datasets were used to calculate minimum, maximum, and mean water levels for the three downriver stations. Outliers are listed in Tables 3 through 5 for Hermann, Waverly, and St. Joseph, respectively. Hundreds of values appeared to be possible outliers at Omaha, Nebraska, and time did not allow for their extraction. For this reason, no outliers were removed from that dataset. For Omaha, the original data were used to calculate water level statistics. Care should be used when viewing results at this station.

The second group of datasets, designated with a "B," had all outliers and anomalous data removed, even those accompanied by an explanation. This was necessary because we were interested in the relationship between water levels and discharge during periods not affected by ice. Anomalous data for this analysis are listed in Tables 3 through 5 for Hermann, Waverly, and St. Joseph, respectively. For Omaha, all data in January, February, March, and December were deleted from the original data to create a "B" dataset (Table 6). However, numerous values in this dataset are still questionable.

## Results and Discussion

Minimum, maximum, and mean water levels and discharge for each year are presented in Tables 7 through 10 for Hermann, Waverly, St. Joseph, and Omaha, respectively. Water levels are also presented in Figures 1 through 4 and discharge in Figures 5 through 8 for Hermann, Waverly, St. Joseph, and Omaha, respectively. The dashed lines in Figures 1 through 8 represent a linear regression of the variable plotted against time.

Trends for minimum, maximum, and mean water levels and discharge are all increasing at the three downriver stations. The same trend was not found at Omaha, but the data used in this analysis were questionable.

Years with the 10 highest and lowest average daily discharges and with the highest and lowest average yearly discharges are presented in Tables 11 through 14 for Hermann, Waverly, St. Joseph, and Omaha, respectively. Analysis included data from 1929 through 1993. All of the above analyses were made using the "A" datasets except for Omaha. At this station, the original data were used.

Discharge exceedence curves are presented in Figures 9 through 12 for Hermann, Waverly, St. Joseph, and Omaha, respectively. Maximum daily discharges at the four stations were: Hermann, 739,000 cfs; Waverly, 611,000 cfs; St. Joseph, 380,000 cfs; and Omaha, 384,000 cfs.

Tables were constructed showing the percent of time water levels were at or above a specific elevation on both a monthly and yearly basis using the "A" datasets for the three downriver stations and the original data at Omaha. Information is presented in Tables 15 through 18 for Hermann, Waverly, St. Joseph, and Omaha, respectively. Because the trends for minimum and mean water levels had been increasing over the period of record (Figs. 1 through 3), a second set of tables was constructed using data collected from 1964 to the present. The last major reservoir on the Missouri River was placed in operation in 1964. Tables 19 through 22 list the 30-year analyses for Harmann, Waverly, St. Joseph, and Omaha, respectively.

The relationship between discharge and elevation was calculated on a yearly basis using a third-order polynomial regression for the "B" datasets. Information from the regressions is presented in Tables 23 through 26 for Hermann, Waverly, St. Joseph, and Omaha, respectively. Plots of the relationship were then made at relatively low discharges, Figures 13 through 17, and relatively high discharges, Figures 18 through 22, for Hermann, Waverly, St. Joseph, and two graphs for Omaha, respectively. Because of the questionable data at Omaha, a second figure was made with only R-squared values >0.9 being used in the analysis.

No data were extrapolated for Figures 13 through 22. If a particular year did not have the required low or high discharge, no point was plotted. High and low discharges were arbitrarily chosen to make sure that at least some years were plotted through time. Discharges were chosen after examining Figures 1 through 4.

An example of the questionable data at Omaha is presented in Figure 23. The R-squared value for these data was 0.48. More than half the years had R-squared values <0.9.

## Acknowledgments

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Table 1. Information concerning main stem reservoirs on the Missouri River

| | Fort Peck Lake | Garrison Dam - Lake Sakakawea | Oahe Dam - Lake Oahe | Big Bend Dam - Lake Sharpe | Fort Randall Dam - Lake Francis Case | Gavins Point Dam - Lewis and Clark Lake |
|---|---|---|---|---|---|---|
| River mile | 1,771.5 | 1,389.9 | 1,072.3 | 987.4 | 880.0 | 811.1 |
| Date of closure | June 24, 1937 | April 15, 1953 | August 3, 1958 | July 24, 1963 | July 20, 1952 | July 31, 1955 |
| Reservoir filling initiated | November 1937 | December 1953 | August 1958 | November 1963 | January 1953 | August 1955 |
| Initially reached min. opr. pool | May 27, 1942 | August 7, 1955 | April 3, 1962 | March 25, 1964 | November 24, 1953 | December 22, 1955 |
| Exclusive flood control | 2,250-2,246<br>975,000 a.f. | 1,854-1,850<br>1,489,000 a.f. | 1,620-1,617<br>1,102,000 a.f. | 1,423-1,422<br>60,000 a.f. | 1,375-1,365<br>986,000 a.f. | 1,210-1,208<br>60,000 a.f. |
| Flood control and multiple use | 2,246-2,234<br>2,717,000 a.f. | 1,850-1,837.5<br>4,222,000 a.f. | 1,617-1,607.5<br>3,201,000 a.f. | 1,422-1,420<br>117,000 a.f. | 1,365-1,350<br>1,315,000 a.f. | 1,208-1,204.5<br>92,000 a.f. |
| Carryover multiple use | 2,234-2,160<br>10,785,000 a.f. | 1,837.5-1,775<br>13,130,000 a.f. | 1,607.5-1,540<br>13,461,000 a.f. | | 1,350-1,320<br>1,648,000 a.f. | |
| Permanent | 2,160-2,030<br>4,211,000 a.f. | 1,775-1,673<br>4,980,000 a.f. | 1,540-1,415<br>5,373,000 a.f. | 1,420-1,345<br>1,682,000 a.f. | 1,320-1,240<br>1,545,000 a.f. | 1,204.5-1,160<br>340,000 a.f. |
| Gross | 2,250-2,030<br>18,688,000 a.f. | 1,854-1,673<br>23,821,000 a.f. | 1,620-1,415<br>23,137,000 a.f. | 1,423-1,345<br>1,859,000 a.f. | 1,375-1,240<br>5,494,000 a.f. | 1,210-1,160<br>492,000 a.f. |

a.f. = acre feet

Table 2. Gage zero values (feet) used to convert stage readings to elevations above sea level

| St. Joseph | | Waverly | | Hermann | | Omaha | |
|---|---|---|---|---|---|---|---|
| Year | Gage zero | Year | Gage zero | Year | Gage zero | Year | Gage zero |
| 1929-1930 | 381.4 | 1929-1930 | 228.0 | 1929 | 68.2 | 1929-1982 | 958.24** |
| 1931-1941 | 0 | 1931-1940 | 0 | 1930 | 68.4 | 1982-1993 | 948.24*** |
| 1942-1993 | 788.18 | 1941-1993 | 645.49 | 1941-1942 | * | | |
| | | | | 1943-1957 | 481.33 | | |
| | | | | 1958 | 481.3 | | |
| | | | | 1959-1961 | 481.4 | | |
| | | | | 1962 | 481.56 | | |
| | | | | 1963 | 481.4 | | |
| | | | | 1964-1975 | 481.56 | | |
| | | | | 1976-1979 | 481.5 | | |
| | | | | 1980-1993 | 481.6 | | |

* For 1941 and 1942, if the elevation was >6.9, the gage zero was 481.33; if the elevation was <6.9, the gage zero was 481.4.

** Day 1 to 273 in 1982

*** Day 274 to 365 in 1982

Table 3. Questionable water level data from Hermann, Missouri. Starred (*) data were considered outliers and were removed from the original Hermann, Missouri, water level data to create dataset A. The remaining data listed were removed from dataset A to create dataset B.

| Year | Julian day | Year | Julian day |
|---|---|---|---|
| 1930 | 20-40 | 1948 | 1-60 |
| 1934 | 179* | 1962 | 96*, 291* |
| 1936 | 19-58, 264-271* | 1972 | 4*, 351 |
| 1940 | 1-60 | 1974 | 1-31 |
| 1946 | 1-5 | 1984 | 366* |

Table 4. Questionable water level data from Waverly, Missouri. Starred (*) data were considered outliers and were removed from the original Waverly, Missouri, water level data to create dataset A. The remaining data listed were removed from dataset A to create dataset B.

| Year | Julian date | Year | Julian date |
|---|---|---|---|
| 1929 | 0-60 | 1963 | 14-40, 345-365 |
| 1930 | 19-40 | 1964 | 1-31 |
| 1934 | 50-60 | 1965 | 40-60 |
| 1935 | 265* | 1966 | 25-59 |
| 1936 | 1-60, 51* | 1967 | 23, 90, 290-365 |
| 1937 | 340-365 | 1968 | 1-30 |
| 1940 | 1-60 | 1970 | 1-30 |
| 1943 | 1-50 | 1972 | 1-33 |
| 1950 | 5-10 | 1976 | 1-40 |
| 1951 | 355-365 | 1977 | all |
| 1955 | 40-60 | 1979 | 1-60 |
| 1957 | 20-40 | 1980 | 366 |
| 1960 | 1-31 | 1981 | 365 |
| 1961 | 340-365 | 1984 | 1-60 |
| 1962 | 1-40 | 1989 | 350-365 |

**Table 5.** Questionable water level data from St. Joseph, Missouri. Starred (*) data were considered outliers and were removed from the original St. Joseph, Missouri, water level data to create dataset A. The remaining data listed were removed from dataset A to create dataset B.

| Year | Julian date | Year | Julian date |
|---|---|---|---|
| 1929 | 1-70 | 1968 | 1-60 |
| 1930 | 16-47 | 1970 | 15-30 |
| 1932 | 29* | 1971 | 1-40, 50-55 |
| 1936 | 1-55 | 1972 | 21, 29-31, 349-366 |
| 1947 | 20-50 | 1973 | 1-23 |
| 1948 | 20-76 | 1974 | 1-40 |
| 1949 | 1-70, 351 | 1976 | 9 |
| 1950 | 1-40 | 1977 | 1-60 |
| 1951 | 20-45 | 1978 | 22-24 |
| 1954 | 1-35 | 1979 | 1-60 |
| 1955 | 10-50 | 1980 | 356*, 364-366* |
| 1958 | 40-65, 227* | 1982 | 25-40 |
| 1961 | 20-45 | 1983 | 365 |
| 1963 | 22-55 | 1984 | 1-41 |
| 1965 | 1-40 | 1985 | 345-365 |
| 1966 | 26 | 1986 | 1-20 |
| 1967 | 20-22, 280-282 | | |

Table 6. Questionable water level data from Omaha, Nebraska. Data listed were removed from the original Omaha, Nebraska, water level dataset to create dataset B. Numerous questionable data still remain in the dataset. No dataset A was created.

| Year | Julian date |
|---|---|
| 1929-1993 | 1-90 and 330-360 |

Table 7. Year, number of observations, and the minimum, maximum, and yearly mean elevation and discharge at Hermann, Missouri, using dataset A

| Year | No. of obs. | Min. elev. | Max. elev. | Mean elev. | Year | No. of obs. | Min. flow | Max. flow | Mean flow |
|---|---|---|---|---|---|---|---|---|---|
| 1928 | NA | NA | NA | NA | 1928 | 92 | 26,600 | 308,000 | 80,062 |
| 1929 | 365 | 137.3 | 161 | 146.22 | 1929 | 365 | 15,000 | 407,000 | 102,996 |
| 1930 | 344 | 137.8 | 151.6 | 143.34 | 1930 | 365 | 15,800 | 164,000 | 54,886 |
| 1931 | 365 | 482.3 | 502.2 | 487 | 1931 | 365 | 15,800 | 267,000 | 45,189 |
| 1932 | 366 | 481.9 | 498.6 | 488.91 | 1932 | 366 | 10,700 | 174,000 | 60,890 |
| 1933 | 365 | 482.8 | 500.6 | 488.44 | 1933 | 365 | 15,400 | 178,000 | 51,613 |
| 1934 | 364 | 481.9 | 494.2 | 485.92 | 1934 | 365 | 12,400 | 99,000 | 32,568 |
| 1935 | 365 | 482.6 | 510 | 490.41 | 1935 | 365 | 10,400 | 454,000 | 79,190 |
| 1936 | 318 | 481.7 | 496.8 | 486.67 | 1936 | 366 | 9,300 | 140,000 | 39,822 |
| 1937 | 365 | 481.3 | 500.2 | 488.42 | 1937 | 365 | 8,300 | 185,000 | 55,442 |
| 1938 | 365 | 481.5 | 503.1 | 489.03 | 1938 | 365 | 13,000 | 229,000 | 60,341 |
| 1939 | 365 | 481.8 | 503.9 | 487.69 | 1939 | 365 | 12,600 | 244,000 | 49,760 |
| 1940 | 306 | 481.9 | 495.3 | 486.29 | 1940 | 366 | 4,200 | 107,000 | 31,430 |
| 1941 | 365 | 483.2 | 506.63 | 490.61 | 1941 | 365 | 18,200 | 283,000 | 72,822 |
| 1942 | 365 | 483.2 | 510.73 | 492.52 | 1942 | 365 | 14,000 | 425,000 | 89,265 |
| 1943 | 365 | 482.73 | 512.23 | 491.7 | 1943 | 365 | 18,600 | 544,000 | 91,603 |
| 1944 | 366 | 482.53 | 511.93 | 492.57 | 1944 | 366 | 17,900 | 565,000 | 99,771 |
| 1945 | 365 | 482.93 | 508.93 | 493.11 | 1945 | 365 | 10,000 | 396,000 | 106,855 |
| 1946 | 360 | 484.53 | 502.33 | 490.32 | 1946 | 365 | 12,000 | 215,000 | 68,223 |
| 1947 | 365 | 481.83 | 512.23 | 492.33 | 1947 | 365 | 12,800 | 484,000 | 101,998 |
| 1948 | 307 | 483.93 | 506.33 | 492.38 | 1948 | 366 | 18,000 | 330,000 | 79,625 |
| 1949 | 365 | 484.03 | 503.73 | 493.22 | 1949 | 365 | 19,500 | 235,000 | 95,884 |
| 1950 | 365 | 482.53 | 504.23 | 492.75 | 1950 | 365 | 15,800 | 263,000 | 90,953 |
| 1951 | 365 | 484.33 | 514.33 | 496.9 | 1951 | 365 | 11,000 | 615,000 | 150,112 |
| 1952 | 366 | 484.13 | 508.23 | 492.09 | 1952 | 366 | 20,600 | 366,000 | 88,669 |
| 1953 | 365 | 483.43 | 499.63 | 489.18 | 1953 | 365 | 16,100 | 174,000 | 54,540 |
| 1954 | 365 | 482.33 | 497.73 | 488.1 | 1954 | 365 | 12,500 | 142,000 | 41,958 |
| 1955 | 365 | 482.63 | 500.53 | 488.68 | 1955 | 365 | 11,800 | 178,000 | 46,365 |
| 1956 | 366 | 482.93 | 494.33 | 486.98 | 1956 | 366 | 13,200 | 85,800 | 32,649 |
| 1957 | 365 | 482.33 | 502.63 | 489.31 | 1957 | 365 | 9,000 | 192,000 | 50,689 |

**Table 7.** Continued.

| Year | No. of obs. | Min. elev. | Max. elev. | Mean elev. | Year | No. of obs. | Min. flow | Max. flow | Mean flow |
|---|---|---|---|---|---|---|---|---|---|
| 1958 | 365 | 483 | 510.2 | 491.91 | 1958 | 365 | 13,400 | 337,000 | 74,011 |
| 1959 | 365 | 482.9 | 502.4 | 490.94 | 1959 | 365 | 12,800 | 189,000 | 61,026 |
| 1960 | 366 | 484.1 | 509.7 | 492.11 | 1960 | 366 | 18,100 | 328,000 | 74,747 |
| 1961 | 365 | 483.4 | 511.9 | 493.98 | 1961 | 365 | 11,000 | 401,000 | 92,056 |
| 1962 | 363 | 483.06 | 506.76 | 492.16 | 1962 | 365 | 13,500 | 275,000 | 73,179 |
| 1963 | 365 | 481.1 | 498.5 | 488.41 | 1963 | 365 | 6,210 | 134,000 | 41,948 |
| 1964 | 366 | 482.96 | 502.46 | 489.11 | 1964 | 366 | 1,200 | 199,000 | 48,633 |
| 1965 | 365 | 484.36 | 508.86 | 493.62 | 1965 | 365 | 21,300 | 304,000 | 86,649 |
| 1966 | 365 | 482.96 | 501.16 | 490.08 | 1966 | 365 | 15,000 | 182,000 | 53,728 |
| 1967 | 365 | 482.86 | 511.36 | 492.23 | 1967 | 365 | 14,300 | 367,000 | 75,783 |
| 1968 | 366 | 484.36 | 502.26 | 491.29 | 1968 | 366 | 19,500 | 181,000 | 64,655 |
| 1969 | 365 | 486.66 | 510.26 | 496.05 | 1969 | 365 | 35,300 | 353,000 | 112,506 |
| 1970 | 365 | 483.26 | 508.86 | 492.92 | 1970 | 365 | 16,500 | 285,000 | 81,189 |
| 1971 | 365 | 485.26 | 502.06 | 492.09 | 1971 | 365 | 28,500 | 206,000 | 76,611 |
| 1972 | 364 | 484.46 | 503.96 | 492 | 1972 | 366 | 20,200 | 222,000 | 75,395 |
| 1973 | 365 | 488.16 | 515.26 | 499.9 | 1973 | 365 | 44,200 | 489,000 | 158,217 |
| 1974 | 335 | 486.76 | 509.66 | 493.76 | 1974 | 365 | 38,300 | 278,000 | 92,040 |
| 1975 | 365 | 486.26 | 508.36 | 493.58 | 1975 | 365 | 39,000 | 268,000 | 89,841 |
| 1976 | 366 | 484.6 | 502.4 | 489.78 | 1976 | 366 | 27,700 | 195,000 | 60,468 |
| 1977 | 365 | 482 | 505.7 | 490.38 | 1977 | 365 | 14,800 | 248,000 | 67,988 |
| 1978 | 365 | 483.1 | 511.7 | 493.37 | 1978 | 365 | 19,900 | 340,000 | 91,671 |
| 1979 | 365 | 483.3 | 509.5 | 493.35 | 1979 | 365 | 21,100 | 282,000 | 89,398 |
| 1980 | 366 | 484.5 | 504 | 490.15 | 1980 | 366 | 21,800 | 196,000 | 59,339 |
| 1981 | 365 | 483.6 | 508.1 | 490.9 | 1981 | 365 | 22,000 | 271,000 | 68,058 |
| 1982 | 365 | 482.4 | 512.8 | 495.69 | 1982 | 365 | 13,900 | 373,000 | 114,836 |
| 1983 | 365 | 485.6 | 514 | 495.93 | 1983 | 365 | 28,000 | 382,000 | 113,205 |
| 1984 | 365 | 484.8 | 510.1 | 497.15 | 1984 | 366 | 26,600 | 310,000 | 129,251 |
| 1985 | 365 | 488.1 | 513.83 | 496.41 | 1985 | 365 | 46,300 | 405,000 | 118,393 |
| 1986 | 365 | 488.7 | 516.73 | 496.75 | 1986 | 365 | 45,600 | 519,000 | 124,465 |
| 1987 | 365 | 488.94 | 506.18 | 494.46 | 1987 | 365 | 48,700 | 254,000 | 97,619 |
| 1988 | 366 | 483.57 | 500.3 | 489.59 | 1988 | 366 | 24,500 | 161,000 | 58,824 |

**Table 7.** Continued.

| Year | No. of obs. | Min. elev. | Max. elev. | Mean elev. | Year | No. of obs. | Min. flow | Max. flow | Mean flow |
|---|---|---|---|---|---|---|---|---|---|
| 1989 | 365 | 481.6 | 503.78 | 488.11 | 1989 | 365 | 18,200 | 207,000 | 49,495 |
| 1990 | 365 | 483.35 | 513.95 | 491.38 | 1990 | 365 | 22,800 | 367,000 | 79,160 |
| 1991 | 365 | 483.21 | 500.64 | 489.21 | 1991 | 365 | 23,500 | 158,000 | 56,963 |
| 1992 | 366 | 484.7 | 509.13 | 492.02 | 1992 | 366 | 29,200 | 295,000 | 84,211 |
| 1993 | 365 | 490.71 | 517.77 | 501.09 | 1993 | 273 | 69,400 | 739,000 | 206,629 |
| 1994 | 67 | 487.82 | 502.05 | 491.53 | 1994 | NA | NA | NA | NA |

**Table 8.** Year, number of observations, and the minimum, maximum, and yearly mean elevation and discharge at Waverly, Missouri, using dataset A

| Year | No. of obs. | Min. elev. | Max. elev. | Mean elev. | Year | No. of obs. | Min. flow | Max. flow | Mean flow |
|---|---|---|---|---|---|---|---|---|---|
| 1928 | NA | NA | NA | NA | 1928 | 92 | 32,000 | 58,000 | 40,478 |
| 1929 | 365 | 462.8 | 481 | 470.25 | 1929 | 365 | 8,200 | 263,000 | 64,972 |
| 1930 | 365 | 461.4 | 476.6 | 469.2 | 1930 | 365 | 8,350 | 145,000 | 43,970 |
| 1931 | 365 | 648.9 | 663 | 652.63 | 1931 | 365 | 10,900 | 144,000 | 29,684 |
| 1932 | 366 | 648.8 | 664.5 | 654.18 | 1932 | 366 | 5,960 | 166,000 | 45,828 |
| 1933 | 365 | 647.7 | 660.9 | 653.12 | 1933 | 365 | 7,000 | 106,000 | 35,442 |
| 1934 | 365 | 647.3 | 658.6 | 651.01 | 1934 | 365 | 6,080 | 76,400 | 21,500 |
| 1935 | 364 | 647.5 | 667.4 | 653.18 | 1935 | 365 | 4,700 | 212,000 | 39,822 |
| 1936 | 365 | 646.9 | 660.5 | 652.45 | 1936 | 366 | 6,000 | 120,000 | 29,540 |
| 1937 | 365 | 646.6 | 660.2 | 652.55 | 1937 | 365 | 3,600 | 104,000 | 30,850 |
| 1938 | 365 | 646.3 | 662.7 | 653.49 | 1938 | 365 | 6,160 | 137,000 | 39,794 |
| 1939 | 365 | 647 | 662.1 | 652.72 | 1939 | 365 | 7,200 | 131,000 | 33,896 |
| 1940 | 366 | 647.1 | 657.9 | 651.83 | 1940 | 366 | 1,700 | 67,000 | 22,871 |
| 1941 | 365 | 648.69 | 666.39 | 654.24 | 1941 | 365 | 10,900 | 183,000 | 41,805 |
| 1942 | 365 | 648.29 | 667.29 | 655.28 | 1942 | 365 | 8,500 | 199,000 | 54,346 |
| 1943 | 365 | 649.59 | 669.69 | 655.51 | 1943 | 365 | 11,900 | 307,000 | 56,061 |
| 1944 | 366 | 647.09 | 669.59 | 656.14 | 1944 | 366 | 11,100 | 337,000 | 69,504 |
| 1945 | 365 | 646.59 | 667.79 | 655.77 | 1945 | 365 | 6,500 | 239,000 | 63,223 |
| 1946 | 365 | 649.29 | 661.59 | 654.18 | 1946 | 365 | 10,500 | 112,000 | 40,888 |
| 1947 | 365 | 647.39 | 670.49 | 656.56 | 1947 | 365 | 4,500 | 270,000 | 65,702 |
| 1948 | 366 | 647.49 | 667.09 | 655.56 | 1948 | 366 | 10,900 | 214,000 | 56,191 |
| 1949 | 365 | 648.19 | 665.89 | 656.35 | 1949 | 365 | 10,300 | 181,000 | 61,557 |
| 1950 | 365 | 649.09 | 667.29 | 656.34 | 1950 | 365 | 9,000 | 194,000 | 61,198 |
| 1951 | 365 | 648.69 | 673.69 | 659.41 | 1951 | 365 | 8,000 | 538,000 | 97,810 |
| 1952 | 366 | 649.89 | 673.39 | 657.14 | 1952 | 366 | 12,300 | 364,000 | 68,557 |
| 1953 | 365 | 648.49 | 662.69 | 655.04 | 1953 | 365 | 12,300 | 123,000 | 42,811 |
| 1954 | 365 | 647.39 | 663.99 | 654.08 | 1954 | 365 | 8,000 | 113,000 | 35,739 |
| 1955 | 365 | 647.29 | 662.49 | 653.35 | 1955 | 365 | 8,020 | 99,600 | 31,031 |
| 1956 | 366 | 648.09 | 659.89 | 653.39 | 1956 | 366 | 9,690 | 64,100 | 28,553 |
| 1957 | 365 | 646.39 | 665.79 | 654.2 | 1957 | 365 | 5,500 | 135,000 | 34,053 |

**Table 8.** Continued.

| Year | No. of obs. | Min. elev. | Max. elev. | Mean elev. | Year | No. of obs. | Min. flow | Max flow | Mean flow |
|---|---|---|---|---|---|---|---|---|---|
| 1958 | 365 | 647.09 | 668.49 | 655.32 | 1958 | 365 | 7,480 | 181,000 | 43,959 |
| 1959 | 365 | 647.49 | 664.99 | 654.95 | 1959 | 365 | 7,500 | 150,000 | 42,353 |
| 1960 | 366 | 647.69 | 671.19 | 655.72 | 1960 | 366 | 9,920 | 246,000 | 51,168 |
| 1961 | 365 | 649.79 | 668.19 | 655.79 | 1961 | 365 | 6,500 | 206,000 | 50,197 |
| 1962 | 365 | 647.69 | 666.49 | 656.29 | 1962 | 365 | 9,600 | 176,000 | 53,392 |
| 1963 | 365 | 646.99 | 662.09 | 654.44 | 1963 | 365 | 5,000 | 94,300 | 34,663 |
| 1964 | 366 | 647.79 | 668.09 | 654.71 | 1964 | 366 | 7,500 | 154,000 | 37,109 |
| 1965 | 365 | 646.79 | 672.09 | 656.53 | 1965 | 365 | 8,880 | 266,000 | 57,343 |
| 1966 | 365 | 650.59 | 663.69 | 655.22 | 1966 | 365 | 8,500 | 119,000 | 38,765 |
| 1967 | 364 | 645.69 | 675.29 | 654.67 | 1967 | 365 | 10,000 | 242,000 | 49,373 |
| 1968 | 366 | 648.19 | 664.89 | 655.78 | 1968 | 366 | 11,200 | 119,000 | 42,023 |
| 1969 | 365 | 650.49 | 667.59 | 658.36 | 1969 | 365 | 15,100 | 183,000 | 66,993 |
| 1970 | 365 | 651.69 | 664.69 | 656.44 | 1970 | 365 | 9,500 | 133,000 | 48,638 |
| 1971 | 365 | 649.69 | 664.79 | 657.74 | 1971 | 365 | 12,200 | 122,000 | 58,976 |
| 1972 | 366 | 649.29 | 663.89 | 657.38 | 1972 | 366 | 13,100 | 121,000 | 57,040 |
| 1973 | 365 | 652.39 | 674.29 | 661.38 | 1973 | 365 | 27,600 | 256,000 | 90,894 |
| 1974 | 365 | 652.49 | 671.39 | 657.18 | 1974 | 365 | 26,800 | 224,000 | 54,319 |
| 1975 | 365 | 650.59 | 664.19 | 658.25 | 1975 | 365 | 17,600 | 105,000 | 59,271 |
| 1976 | 366 | 650.49 | 663.89 | 656.33 | 1976 | 366 | 22,000 | 107,000 | 46,514 |
| 1977 | 365 | 651.79 | 673.69 | 657.23 | 1977 | 90 | 10,000 | 52,300 | 26,414 |
| 1978 | 365 | 651.19 | 669.59 | 659.53 | 1978 | 275 | 35,700 | 149,000 | 70,185 |
| 1979 | 365 | 651.44 | 669.36 | 659.43 | 1979 | 365 | 17,000 | 189,000 | 66,035 |
| 1980 | 366 | 645.52 | 665.98 | 656.62 | 1980 | 366 | 20,600 | 163,000 | 48,193 |
| 1981 | 365 | 645.59 | 666.78 | 655.95 | 1981 | 365 | 15,900 | 135,000 | 40,245 |
| 1982 | 365 | 648.17 | 672.55 | 659.57 | 1982 | 365 | 12,000 | 202,000 | 69,197 |
| 1983 | 365 | 645.5 | 671.09 | 659.97 | 1983 | 365 | 22,000 | 211,000 | 75,161 |
| 1984 | 366 | 655.69 | 674.49 | 662.55 | 1984 | 366 | 22,400 | 242,000 | 89,807 |
| 1985 | 365 | 653.49 | 671.74 | 659.07 | 1985 | 365 | 29,000 | 204,000 | 59,980 |
| 1986 | 365 | 652.49 | 670.15 | 661.1 | 1986 | 365 | 32,000 | 174,000 | 79,945 |
| 1987 | 365 | 655.72 | 670.86 | 659.9 | 1987 | 365 | 40,400 | 188,000 | 72,729 |
| 1988 | 366 | 651.38 | 659.51 | 655.67 | 1988 | 366 | 19,800 | 65,900 | 39,550 |

Table 8. Continued.

| Year | No. of obs. | Min. elev. | Max. elev. | Mean elev. | Year | No. of obs. | Min. flow | Max. flow | Mean flow |
|---|---|---|---|---|---|---|---|---|---|
| 1989 | 365 | 648.49 | 671.52 | 655.02 | 1989 | 365 | 11,100 | 193,000 | 36,314 |
| 1990 | 365 | 650.1 | 670.59 | 655.83 | 1990 | 365 | 9,000 | 185,000 | 41,115 |
| 1991 | 365 | 650.74 | 666.06 | 655.49 | 1991 | 365 | 15,000 | 122,000 | 36,849 |
| 1992 | 366 | 652.27 | 670.63 | 657.94 | 1992 | 366 | 21,100 | 176,000 | 53,307 |
| 1993 | 365 | 654.58 | 676.69 | 663.37 | 1993 | 273 | 33,800 | 611,000 | 128,012 |
| 1994 | 69 | 654.96 | 663.27 | 657.17 | 1994 | NA | NA | NA | NA |

**Table 9.** Year, number of observations, and the minimum, maximum, and yearly mean elevation and discharge at St. Joseph, Missouri, using dataset A

| Year | No. of obs. | Min. elev. | Max. elev. | Mean elev. | Year | No. of obs. | Min. flow | Max. flow | Mean flow |
|---|---|---|---|---|---|---|---|---|---|
| 1928 | NA | NA | NA | NA | 1928 | 92 | 9,600 | 52,600 | 26,712 |
| 1929 | 365 | 761.9 | 772.9 | 766.07 | 1929 | 365 | 8,800 | 196,000 | 47,776 |
| 1930 | 365 | 760.1 | 770.5 | 765.52 | 1930 | 365 | 9,400 | 106,000 | 36,811 |
| 1931 | 365 | 791.7 | 800.5 | 795.08 | 1931 | 365 | 8,900 | 64,200 | 22,524 |
| 1932 | 365 | 789.3 | 803.7 | 796.08 | 1932 | 366 | 3,730 | 149,000 | 38,511 |
| 1933 | 365 | 789.2 | 802.3 | 795.57 | 1933 | 365 | 4,490 | 106,000 | 31,775 |
| 1934 | 365 | 789.4 | 800.6 | 793.85 | 1934 | 365 | 4,200 | 76,600 | 19,471 |
| 1935 | 365 | 789.3 | 803.6 | 794.8 | 1935 | 365 | 3,500 | 116,000 | 28,250 |
| 1936 | 366 | 789.3 | 802.2 | 794.21 | 1936 | 366 | 5,800 | 106,000 | 25,404 |
| 1937 | 365 | 788.8 | 803 | 794.62 | 1937 | 365 | 2,300 | 98,800 | 26,517 |
| 1938 | 365 | 789.2 | 805.2 | 796.08 | 1938 | 365 | 5,330 | 122,000 | 34,462 |
| 1939 | 365 | 789.3 | 804 | 794.77 | 1939 | 365 | 6,300 | 138,000 | 29,840 |
| 1940 | 366 | 788.2 | 800.6 | 793.42 | 1940 | 366 | 3,700 | 62,900 | 20,384 |
| 1941 | 365 | 789.4 | 804.5 | 795.27 | 1941 | 365 | 6,890 | 114,000 | 28,976 |
| 1942 | 365 | 789.48 | 805.18 | 796.48 | 1942 | 365 | 7,000 | 132,000 | 40,606 |
| 1943 | 365 | 789.78 | 806.68 | 796.69 | 1943 | 365 | 6,940 | 152,000 | 45,353 |
| 1944 | 366 | 789.28 | 807.28 | 797.32 | 1944 | 366 | 4,930 | 161,000 | 52,614 |
| 1945 | 365 | 788.78 | 805.38 | 796.6 | 1945 | 365 | 2,980 | 148,000 | 45,497 |
| 1946 | 365 | 791.38 | 802.28 | 795.93 | 1946 | 365 | 5,600 | 103,000 | 34,875 |
| 1947 | 365 | 790.38 | 808.48 | 797.66 | 1947 | 365 | 4,000 | 179,000 | 53,317 |
| 1948 | 366 | 790.08 | 805.48 | 797.53 | 1948 | 366 | 7,000 | 154,000 | 47,517 |
| 1949 | 365 | 789.38 | 808.18 | 798.61 | 1949 | 365 | 6,880 | 168,000 | 48,270 |
| 1950 | 365 | 789.48 | 807.18 | 797.38 | 1950 | 365 | 6,080 | 175,000 | 49,097 |
| 1951 | 365 | 790.18 | 808.08 | 798.95 | 1951 | 365 | 5,500 | 189,000 | 63,541 |
| 1952 | 366 | 792.38 | 814.98 | 798.8 | 1952 | 366 | 12,100 | 380,000 | 60,551 |
| 1953 | 365 | 792.18 | 805.08 | 798.04 | 1953 | 365 | 10,400 | 117,000 | 39,212 |
| 1954 | 365 | 791.48 | 803.88 | 797.27 | 1954 | 365 | 7,000 | 96,800 | 31,606 |
| 1955 | 365 | 790.68 | 803.88 | 796.9 | 1955 | 365 | 4,500 | 77,600 | 27,581 |
| 1956 | 366 | 791.58 | 801.28 | 796.67 | 1956 | 366 | 7,080 | 52,600 | 27,423 |
| 1957 | 365 | 790.48 | 805.68 | 796.96 | 1957 | 365 | 3,800 | 121,000 | 27,476 |

Table 9. Continued.

| Year | No. of obs. | Min. elev. | Max. elev. | Mean elev. | Year | No. of obs. | Min. flow | Max. flow | Mean flow |
|---|---|---|---|---|---|---|---|---|---|
| 1958 | 364 | 791.38 | 806.38 | 797.34 | 1958 | 365 | 7,000 | 126,000 | 31,904 |
| 1959 | 365 | 791.18 | 805.68 | 797.33 | 1959 | 365 | 6,700 | 124,000 | 32,945 |
| 1960 | 366 | 791.58 | 810.18 | 797.92 | 1960 | 366 | 8,400 | 174,000 | 38,539 |
| 1961 | 365 | 790.88 | 805.28 | 797.24 | 1961 | 365 | 6,000 | 99,200 | 31,231 |
| 1962 | 365 | 790.68 | 807.18 | 798.25 | 1962 | 365 | 5,600 | 134,000 | 39,931 |
| 1963 | 365 | 792.08 | 804.38 | 797.43 | 1963 | 365 | 4,000 | 85,400 | 30,463 |
| 1964 | 366 | 792.38 | 806.58 | 797.65 | 1964 | 366 | 7,000 | 104,000 | 31,973 |
| 1965 | 365 | 793.48 | 808.68 | 798.08 | 1965 | 365 | 8,200 | 158,000 | 43,108 |
| 1966 | 365 | 792.98 | 803.98 | 797.76 | 1966 | 365 | 8,160 | 81,800 | 35,274 |
| 1967 | 365 | 792.18 | 810.78 | 798.26 | 1967 | 365 | 9,500 | 158,000 | 38,769 |
| 1968 | 366 | 791.38 | 802.38 | 798.06 | 1968 | 366 | 8,300 | 76,300 | 34,803 |
| 1969 | 365 | 792.28 | 807.08 | 799.99 | 1969 | 365 | 10,300 | 112,000 | 52,790 |
| 1970 | 365 | 793.58 | 802.18 | 798.59 | 1970 | 365 | 11,500 | 65,200 | 41,896 |
| 1971 | 365 | 794.28 | 806.88 | 800.38 | 1971 | 365 | 9,500 | 123,000 | 52,534 |
| 1972 | 366 | 790.58 | 807.78 | 800.35 | 1972 | 366 | 9,520 | 108,000 | 51,763 |
| 1973 | 365 | 794.98 | 813.68 | 800.71 | 1973 | 365 | 16,900 | 195,000 | 59,180 |
| 1974 | 365 | 794.78 | 806.78 | 798.97 | 1974 | 365 | 23,000 | 106,000 | 43,037 |
| 1975 | 365 | 792.38 | 805.58 | 800.25 | 1975 | 365 | 16,900 | 90,500 | 52,608 |
| 1976 | 366 | 791.68 | 805.08 | 798.29 | 1976 | 366 | 17,000 | 89,700 | 42,415 |
| 1977 | 365 | 792.78 | 807.38 | 799.01 | 1977 | 365 | 14,000 | 111,000 | 39,633 |
| 1978 | 365 | 792.08 | 810.38 | 800.35 | 1978 | 365 | 16,800 | 172,000 | 54,995 |
| 1979 | 365 | 795.58 | 811.98 | 800.76 | 1979 | 365 | 21,000 | 166,000 | 54,627 |
| 1980 | 362 | 793.28 | 805.74 | 798.28 | 1980 | 366 | 18,000 | 96,500 | 41,825 |
| 1981 | 365 | 791.74 | 802.91 | 797.01 | 1981 | 365 | 13,500 | 67,400 | 35,922 |
| 1982 | 365 | 792.28 | 809.68 | 800.11 | 1982 | 365 | 11,700 | 154,000 | 53,142 |
| 1983 | 365 | 788.18 | 809.59 | 801.4 | 1983 | 365 | 20,500 | 141,000 | 65,635 |
| 1984 | 366 | 796.09 | 813.84 | 803.34 | 1984 | 366 | 21,000 | 195,000 | 75,454 |
| 1985 | 365 | 794.22 | 806.07 | 799.13 | 1985 | 365 | 24,000 | 84,500 | 46,490 |
| 1986 | 365 | 794.85 | 810.48 | 802.23 | 1986 | 365 | 28,000 | 149,000 | 65,118 |
| 1987 | 365 | 795.68 | 811.79 | 800.33 | 1987 | 365 | 29,700 | 202,000 | 56,209 |
| 1988 | 366 | 792.42 | 800.72 | 797.32 | 1988 | 366 | 18,100 | 54,200 | 36,707 |

Table 9. Continued.

| Year | No. of obs. | Min. elev. | Max. elev. | Mean elev. | Year | No. of obs. | Min. flow | Max. flow | Mean flow |
|---|---|---|---|---|---|---|---|---|---|
| 1989 | 365 | 789.46 | 810.57 | 796.02 | 1989 | 365 | 4,600 | 161,000 | 31,913 |
| 1990 | 365 | 788.28 | 809.65 | 796.1 | 1990 | 365 | 7,330 | 134,000 | 32,610 |
| 1991 | 365 | 791.47 | 808.1 | 796.52 | 1991 | 365 | 16,100 | 111,000 | 33,635 |
| 1992 | 366 | 792.95 | 809.88 | 797.88 | 1992 | 366 | 20,400 | 121,000 | 39,633 |
| 1993 | 365 | 793.29 | 820.75 | 801.77 | 1993 | 273 | 22,200 | 328,000 | 77,53[illegible] |
| 1994 | 67 | 793.58 | 804.74 | 796.59 | 1994 | NA | NA | NA | NA |

**Table 10.** Year, number of observations, and the minimum, maximum, and yearly mean elevation and discharge at Omaha, Nebraska, using the original dataset

| Year | No. of obs. | Min. elev. | Max. elev. | Mean elev. | Year | No. of obs. | Min. flow | Max. flow | Mean flow |
|---|---|---|---|---|---|---|---|---|---|
| 1928 | NA | NA | NA | NA | 1928 | 122 | 6,740 | 37,500 | 19,013 |
| 1929 | 365 | 960.04 | 972.52 | 964.92 | 1929 | 365 | 5,720 | 198,000 | 35,743 |
| 1930 | 365 | 961.56 | 970.23 | 966.4 | 1930 | 365 | 5,750 | 84,400 | 26,374 |
| 1931 | 365 | 961.44 | 969.02 | 964.81 | 1931 | 365 | 4,940 | 51,700 | 15,008 |
| 1932 | 366 | 961.54 | 973.22 | 966.04 | 1932 | 366 | 4,000 | 129,000 | 27,294 |
| 1933 | 365 | 961.21 | 971.04 | 965.7 | 1933 | 365 | 3,500 | 95,800 | 24,985 |
| 1934 | 365 | 961.34 | 971.06 | 964.45 | 1934 | 365 | 3,600 | 85,900 | 15,478 |
| 1935 | 365 | 960.59 | 974.89 | 965.48 | 1935 | 365 | 3,700 | 97,100 | 20,150 |
| 1936 | 366 | 961.34 | 974.19 | 965.7 | 1936 | 366 | 4,600 | 84,100 | 19,674 |
| 1937 | 365 | 959.99 | 976.24 | 965.55 | 1937 | 365 | 2,200 | 109,000 | 20,916 |
| 1938 | 365 | 961.54 | 976.89 | 966.58 | 1938 | 365 | 5,900 | 116,000 | 28,258 |
| 1939 | 365 | 961.14 | 977.44 | 965.3 | 1939 | 365 | 5,300 | 140,000 | 24,624 |
| 1940 | 366 | 959.89 | 968.98 | 963.44 | 1940 | 366 | 3,000 | 53,100 | 16,110 |
| 1941 | 365 | 959.75 | 975.31 | 964.73 | 1941 | 365 | 3,940 | 105,000 | 22,447 |
| 1942 | 365 | 959.61 | 976.45 | 965.8 | 1942 | 365 | 3,620 | 120,000 | 31,619 |
| 1943 | 365 | 961.1 | 980.52 | 966.14 | 1943 | 365 | 7,000 | 190,000 | 38,149 |
| 1944 | 366 | 960.26 | 977.54 | 965.95 | 1944 | 366 | 10,400 | 148,000 | 41,046 |
| 1945 | 365 | 960.1 | 977.21 | 965.08 | 1945 | 365 | 4,500 | 105,000 | 32,903 |
| 1946 | 365 | 958.05 | 971.08 | 963.92 | 1946 | 365 | 2,500 | 80,700 | 25,770 |
| 1947 | 365 | 958.25 | 977.25 | 965.68 | 1947 | 365 | 3,500 | 149,000 | 40,614 |
| 1948 | 366 | 958.29 | 971.68 | 965.42 | 1948 | 366 | 6,260 | 104,000 | 39,635 |
| 1949 | 363 | 958.25 | 968.14 | 964.42 | 1949 | 365 | 3,830 | 182,000 | 34,724 |
| 1950 | 364 | 958.26 | 968.21 | 963.3 | 1950 | 365 | 4,740 | 192,000 | 39,130 |

Table 10. Continued.

| Year | No. of obs. | Min. elev. | Max. elev. | Mean elev. | Year | No. of obs. | Min. flow | Max. flow | Mean flow |
|---|---|---|---|---|---|---|---|---|---|
| 1951 | 364 | 958.35 | 968.23 | 964 | 1951 | 365 | 7,000 | 149,000 | 45,019 |
| 1952 | 366 | 958.25 | 968.22 | 962.94 | 1952 | 366 | 6,780 | 384,000 | 46,259 |
| 1953 | 365 | 958.42 | 968.2 | 962.59 | 1953 | 365 | 6,000 | 111,000 | 33,355 |
| 1954 | 365 | 958.65 | 967.89 | 962.46 | 1954 | 365 | 5,800 | 82,400 | 25,960 |
| 1955 | 365 | 958.26 | 965.22 | 961.97 | 1955 | 365 | 2,970 | 41,900 | 23,426 |
| 1956 | 366 | 958.28 | 965.47 | 961.91 | 1956 | 366 | 4,160 | 40,200 | 23,623 |
| 1957 | 361 | 958.25 | 966.36 | 961.67 | 1957 | 365 | 4,520 | 50,000 | 20,837 |
| 1958 | 364 | 958.26 | 965.43 | 961.86 | 1958 | 365 | 4,400 | 36,700 | 20,521 |
| 1959 | 365 | 958.28 | 967.73 | 962.03 | 1959 | 365 | 4,430 | 55,000 | 21,624 |
| 1960 | 366 | 958.27 | 967.19 | 962.27 | 1960 | 366 | 4,430 | 116,000 | 24,466 |
| 1961 | 365 | 958.28 | 965.67 | 961.97 | 1961 | 365 | 2,440 | 40,400 | 20,539 |
| 1962 | 365 | 958.36 | 967.89 | 963.08 | 1962 | 365 | 3,300 | 104,000 | 26,740 |
| 1963 | 365 | 959.51 | 967.7 | 963.22 | 1963 | 365 | 6,000 | 57,400 | 23,078 |
| 1964 | 366 | 958.45 | 967.88 | 963.04 | 1964 | 366 | 3,200 | 54,600 | 22,956 |
| 1965 | 365 | 958.62 | 968.2 | 963.97 | 1965 | 365 | 7,720 | 66,600 | 26,860 |
| 1966 | 365 | 958.36 | 967.8 | 964.3 | 1966 | 365 | 11,500 | 52,900 | 28,210 |
| 1967 | 365 | 958.49 | 967.88 | 963.93 | 1967 | 365 | 4,800 | 62,200 | 28,394 |
| 1968 | 366 | 959.03 | 967.36 | 964.43 | 1968 | 366 | 6,000 | 47,000 | 28,603 |
| 1969 | 365 | 960.98 | 975.01 | 966.28 | 1969 | 365 | 10,500 | 99,500 | 39,804 |
| 1970 | 365 | 960.73 | 968.28 | 965.35 | 1970 | 365 | 10,000 | 47,200 | 34,170 |
| 1971 | 365 | 960.69 | 972.21 | 966.4 | 1971 | 365 | 9,000 | 79,700 | 42,631 |
| 1972 | 366 | 960.33 | 970.6 | 965.92 | 1972 | 366 | 5,460 | 66,800 | 41,686 |
| 1973 | 365 | 961.21 | 968.41 | 965.32 | 1973 | 365 | 17,500 | 52,400 | 31,333 |

Table 10. Continued.

| Year | No. of obs. | Min. elev. | Max. elev. | Mean elev. | Year | No. of obs. | Min. flow | Max. flow | Mean flow |
|---|---|---|---|---|---|---|---|---|---|
| 1974 | 365 | 961.55 | 968.43 | 965.34 | 1974 | 365 | 13,300 | 47,900 | 30,672 |
| 1975 | 365 | 959.64 | 971.59 | 966.71 | 1975 | 365 | 8,700 | 73,900 | 44,648 |
| 1976 | 366 | 959.63 | 967.48 | 965.02 | 1976 | 366 | 13,200 | 47,000 | 35,587 |
| 1977 | 365 | 958.64 | 967.76 | 964.28 | 1977 | 365 | 6,140 | 43,900 | 28,987 |
| 1978 | 365 | 958.54 | 971.79 | 965.76 | 1978 | 365 | 6,710 | 81,200 | 41,522 |
| 1979 | 365 | 961.36 | 970.78 | 965.99 | 1979 | 365 | 18,500 | 82,800 | 40,536 |
| 1980 | 366 | 960.01 | 968.18 | 964.61 | 1980 | 366 | 15,500 | 47,000 | 32,330 |
| 1981 | 365 | 958.4 | 967.84 | 963.7 | 1981 | 365 | 12,900 | 47,200 | 28,893 |
| 1982 | 365 | 956.5 | 968.77 | 964.75 | 1982 | 365 | 10,000 | 58,000 | 35,393 |
| 1983 | 366 | 960.9 | 973.98 | 966.54 | 1983 | 365 | 15,500 | 80,500 | 43,065 |
| 1984 | 366 | 961.71 | 977.14 | 968.08 | 1984 | 366 | 22,200 | 114,000 | 48,703 |
| 1985 | 349 | 959.13 | 971.01 | 965.27 | 1985 | 365 | 14,900 | 68,800 | 34,672 |
| 1986 | 360 | 960.76 | 971.65 | 967.03 | 1986 | 365 | 17,000 | 76,300 | 45,122 |
| 1987 | 365 | 960.2 | 970.18 | 965.46 | 1987 | 365 | 19,500 | 58,800 | 35,858 |
| 1988 | 364 | 958.47 | 967.1 | 964.07 | 1988 | 366 | 12,900 | 42,200 | 30,036 |
| 1989 | 359 | 956.36 | 967.7 | 962.62 | 1989 | 273 | 6,500 | 44,500 | 27,912 |
| 1990 | 362 | 957.03 | 973.84 | 962.04 | 1990 | 92 | 8,000 | 32,600 | 18,933 |
| 1991 | 361 | 957.63 | 972.27 | 962.69 | 1991 | 365 | 12,600 | 74,100 | 25,951 |
| 1992 | 364 | 958.97 | 969.43 | 963.08 | 1992 | 366 | 16,000 | 52,500 | 27,326 |
| 1993 | 365 | 958.11 | 978.15 | 965.61 | | | | | |

**Table 11.** Years with the 10 highest and lowest daily discharges and with the highest and lowest yearly discharges averaged over the year at Hermann, Missouri. Analysis included data from 1929 through 1993 using dataset A.

| Maximum daily discharge | | Minimum daily discharge | | Maximum yearly discharge | | Minimum yearly discharge | |
|---|---|---|---|---|---|---|---|
| Year | cfs | Year | cfs | Year | cfs | Year | cfs |
| 1993 | 739,000 | 1940 | 4,200 | 1993 | 206,629 | 1940 | 31,430 |
| 1951 | 615,000 | 1963 | 6,210 | 1973 | 158,217 | 1934 | 32,568 |
| 1944 | 565,000 | 1937 | 8,300 | 1951 | 150,112 | 1956 | 32,649 |
| 1943 | 544,000 | 1957 | 9,000 | 1984 | 129,251 | 1936 | 39,822 |
| 1986 | 519,000 | 1936 | 9,300 | 1986 | 124,465 | 1963 | 41,948 |
| 1973 | 489,000 | 1945 | 10,000 | 1985 | 118,393 | 1954 | 41,958 |
| 1947 | 484,000 | 1935 | 10,400 | 1982 | 114,836 | 1931 | 45,189 |
| 1935 | 454,000 | 1932 | 10,700 | 1983 | 113,205 | 1955 | 46,365 |
| 1942 | 425,000 | 1961 | 11,000 | 1969 | 112,506 | 1964 | 48,633 |
| 1929 | 407,000 | 1951 | 11,000 | 1945 | 106,855 | 1989 | 49,495 |

Table 12. Years with the 10 highest and lowest daily discharges and with the highest and lowest yearly discharges averaged over the year at Waverly, Missouri. Analysis included data from 1929 through 1993 using dataset A.

| Maximum daily discharge | | Minimum daily discharge | | Maximum yearly discharge | | Minimum yearly discharge | |
|---|---|---|---|---|---|---|---|
| Year | cfs | Year | cfs | Year | cfs | Year | cfs |
| 1993 | 611,000 | 1940 | 1,700 | 1993 | 128,012 | 1934 | 21,500 |
| 1951 | 538,000 | 1937 | 3,600 | 1951 | 97,810 | 1940 | 22,871 |
| 1952 | 364,000 | 1947 | 4,500 | 1973 | 90,894 | 1977 | 26,414 |
| 1944 | 337,000 | 1935 | 4,700 | 1984 | 89,806 | 1956 | 28,553 |
| 1943 | 307,000 | 1963 | 5,000 | 1986 | 79,945 | 1936 | 29,540 |
| 1947 | 270,000 | 1957 | 5,500 | 1983 | 75,161 | 1931 | 29,684 |
| 1929 | 263,000 | 1932 | 5,960 | 1987 | 72,729 | 1937 | 30,850 |
| 1965 | 266,000 | 1936 | 6,000 | 1978 | 70,185 | 1955 | 31,031 |
| 1973 | 256,000 | 1934 | 6,080 | 1944 | 69,504 | 1939 | 33,896 |
| 1960 | 246,000 | 1938 | 6,160 | 1982 | 69,197 | 1957 | 34,053 |

Table 13. Years with the 10 highest and lowest daily discharges and with the highest and lowest yearly discharges averaged over the year at St. Joseph, Missouri. Analysis included data from 1929 through 1993 using dataset A.

| Maximum daily discharge | | Minimum daily discharge | | Maximum yearly discharge | | Minimum yearly discharge | |
|---|---|---|---|---|---|---|---|
| Year | cfs | Year | cfs | Year | cfs | Year | cfs |
| 1952 | 380,000 | 1937 | 2,300 | 1993 | 77,539 | 1934 | 19,471 |
| 1993 | 328,000 | 1945 | 2,980 | 1984 | 75,454 | 1940 | 20,384 |
| 1987 | 202,000 | 1935 | 3,500 | 1983 | 65,635 | 1931 | 22,524 |
| 1929 | 196,000 | 1940 | 3,700 | 1986 | 65,118 | 1936 | 25,404 |
| 1984 | 195,000 | 1932 | 3,730 | 1951 | 63,541 | 1937 | 26,517 |
| 1973 | 195,000 | 1957 | 3,800 | 1952 | 60,551 | 1928 | 26,712 |
| 1951 | 189,000 | 1947 | 4,000 | 1973 | 59,180 | 1956 | 27,423 |
| 1947 | 179,000 | 1963 | 4,000 | 1987 | 56,209 | 1957 | 27,476 |
| 1950 | 175,000 | 1934 | 4,200 | 1978 | 54,995 | 1955 | 27,581 |
| 1960 | 174,000 | 1933 | 4,490 | 1979 | 54,627 | 1935 | 28,250 |

Table 14. Years with the 10 highest and lowest daily discharges and with the highest and lowest yearly discharges averaged over the year at Omaha, Nebraska. Analysis included data from 1929 through 1993.

| Maximum daily discharge | | Minimum daily discharge | | Maximum yearly discharge | | Minimum yearly discharge | |
|---|---|---|---|---|---|---|---|
| Year | cfs | Year | cfs | Year | cfs | Year | cfs |
| 1952 | 384,000 | 1937 | 2,200 | 1984 | 48,703 | 1931 | 15,008 |
| 1929 | 198,000 | 1961 | 2,440 | 1952 | 46,259 | 1934 | 15,479 |
| 1950 | 192,000 | 1946 | 2,500 | 1986 | 45,122 | 1940 | 16,110 |
| 1943 | 190,000 | 1955 | 2,970 | 1951 | 45,019 | 1990 | 18,933 |
| 1949 | 182,000 | 1940 | 3,000 | 1975 | 44,648 | 1928 | 19,013 |
| 1951 | 149,000 | 1964 | 3,200 | 1983 | 43,065 | 1936 | 19,674 |
| 1947 | 149,000 | 1962 | 3,300 | 1971 | 42,631 | 1935 | 20,150 |
| 1944 | 148,000 | 1933 | 3,500 | 1972 | 41,686 | 1958 | 20,521 |
| 1939 | 140,000 | 1947 | 3,500 | 1978 | 41,522 | 1961 | 20,539 |
| 1932 | 129,000 | 1934 | 3,600 | 1944 | 41,046 | 1957 | 20,837 |

**Table 15.** The percentage of time water levels are above specific elevations at the Corps of Engineers gage at Hermann on the Missouri River from 1931 through 1993 using dataset B.

| Elev. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 517 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 516 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| 515 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.3 | 0.2 | 0.0 | 0.2 | 0.0 | 0.0 | 0.1 |
| 514 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.6 | 0.2 | 0.0 | 0.2 | 0.0 | 0.0 | 0.1 |
| 513 | 0.0 | 0.2 | 0.0 | 0.5 | 0.2 | 0.0 | 0.8 | 0.3 | 0.1 | 0.3 | 0.0 | 0.0 | 0.2 |
| 512 | 0.0 | 0.2 | 0.1 | 0.7 | 0.4 | 0.1 | 1.6 | 0.3 | 0.2 | 0.4 | 0.0 | 0.1 | 0.4 |
| 511 | 0.0 | 0.3 | 0.7 | 1.1 | 0.8 | 0.3 | 2.6 | 0.4 | 0.4 | 0.5 | 0.0 | 0.2 | 0.6 |
| 510 | 0.0 | 0.3 | 1.0 | 1.6 | 0.9 | 0.7 | 2.8 | 0.6 | 0.4 | 0.6 | 0.0 | 0.3 | 0.8 |
| 509 | 0.0 | 0.3 | 1.2 | 2.2 | 1.4 | 1.7 | 3.5 | 0.7 | 0.4 | 1.0 | 0.1 | 0.3 | 1.1 |
| 508 | 0.0 | 0.3 | 1.4 | 3.3 | 2.1 | 3.2 | 4.0 | 1.0 | 0.7 | 1.3 | 0.3 | 0.4 | 1.5 |
| 507 | 0.0 | 0.3 | 1.8 | 4.5 | 2.9 | 4.6 | 4.8 | 1.1 | 1.1 | 1.8 | 0.4 | 0.6 | 2.0 |
| 506 | 0.1 | 0.3 | 2.4 | 6.3 | 4.1 | 6.4 | 5.6 | 1.3 | 1.7 | 2.3 | 0.4 | 0.6 | 2.7 |
| 505 | 0.1 | 0.4 | 3.7 | 7.6 | 5.4 | 8.4 | 6.0 | 1.4 | 2.4 | 2.7 | 0.8 | 0.8 | 3.3 |
| 504 | 0.3 | 0.5 | 5.1 | 10.0 | 7.8 | 10.1 | 7.1 | 1.6 | 2.8 | 3.3 | 1.3 | 1.1 | 4.3 |
| 503 | 0.5 | 0.9 | 6.3 | 12.4 | 9.9 | 12.4 | 8.3 | 2.0 | 3.6 | 3.8 | 1.8 | 1.2 | 5.3 |
| 502 | 0.7 | 1.0 | 7.3 | 14.7 | 11.9 | 14.0 | 9.4 | 2.4 | 4.0 | 4.2 | 2.7 | 1.6 | 6.2 |
| 501 | 0.7 | 1.4 | 8.8 | 18.2 | 14.6 | 17.1 | 10.6 | 2.9 | 4.9 | 4.7 | 3.9 | 2.1 | 7.5 |
| 500 | 1.0 | 2.4 | 10.8 | 21.1 | 17.7 | 21.3 | 12.1 | 3.6 | 5.5 | 5.8 | 5.4 | 2.8 | 9.2 |
| 499 | 1.6 | 4.1 | 13.5 | 25.0 | 21.4 | 25.8 | 14.8 | 4.3 | 6.8 | 7.2 | 6.7 | 3.4 | 11.3 |
| 498 | 2.1 | 6.2 | 16.1 | 29.2 | 25.5 | 31.3 | 18.8 | 5.3 | 7.9 | 8.5 | 8.5 | 4.3 | 13.7 |
| 497 | 3.1 | 7.9 | 19.5 | 32.8 | 31.2 | 35.8 | 22.7 | 6.2 | 9.1 | 10.1 | 10.3 | 5.5 | 16.3 |

Table 15. Continued.

| Elev. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 496 | 3.8 | 10.2 | 23.1 | 37.7 | 37.8 | 41.5 | 27.0 | 7.4 | 11.5 | 12.4 | 12.7 | 7.8 | 19.5 |
| 495 | 5.1 | 12.3 | 28.5 | 42.0 | 43.9 | 47.2 | 32.3 | 10.1 | 13.6 | 14.2 | 15.2 | 9.4 | 23.0 |
| 494 | 6.9 | 15.7 | 33.7 | 48.0 | 49.1 | 55.8 | 38.8 | 14.0 | 17.1 | 16.3 | 18.5 | 11.1 | 27.2 |
| 493 | 9.2 | 19.8 | 40.6 | 53.3 | 54.7 | 64.5 | 45.6 | 19.7 | 21.3 | 19.0 | 23.4 | 14.4 | 32.3 |
| 492 | 12.0 | 26.2 | 47.5 | 60.3 | 60.1 | 70.3 | 55.0 | 29.0 | 26.8 | 24.3 | 27.7 | 18.2 | 38.3 |
| 491 | 15.9 | 31.0 | 54.5 | 67.4 | 67.5 | 77.1 | 63.9 | 40.6 | 35.6 | 33.1 | 35.3 | 22.1 | 45.5 |
| 490 | 19.9 | 35.7 | 62.2 | 74.8 | 77.6 | 84.2 | 73.3 | 52.6 | 46.3 | 42.3 | 42.4 | 27.7 | 53.5 |
| 489 | 25.9 | 42.6 | 69.7 | 83.4 | 85.2 | 89.5 | 82.1 | 64.7 | 58.3 | 52.3 | 50.0 | 33.1 | 61.7 |
| 488 | 34.4 | 51.5 | 76.7 | 90.8 | 92.4 | 95.0 | 90.6 | 79.1 | 71.9 | 67.5 | 61.8 | 41.4 | 71.4 |
| 487 | 43.1 | 61.9 | 82.6 | 96.3 | 96.5 | 98.1 | 95.7 | 87.8 | 86.0 | 82.6 | 72.6 | 50.3 | 79.8 |
| 486 | 52.9 | 72.7 | 89.2 | 98.7 | 98.7 | 99.2 | 97.6 | 93.9 | 90.4 | 87.1 | 78.8 | 60.2 | 85.2 |
| 485 | 67.2 | 84.5 | 95.8 | 100.0 | 99.8 | 100.0 | 98.7 | 95.5 | 93.7 | 89.3 | 84.9 | 74.3 | 90.5 |
| 484 | 81.0 | 94.2 | 99.8 | 100.0 | 100.0 | 100.0 | 99.9 | 96.2 | 96.5 | 93.1 | 90.7 | 83.9 | 94.7 |
| 483 | 90.8 | 98.5 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 98.9 | 99.1 | 96.1 | 97.4 | 94.3 | 98.0 |
| 482 | 98.7 | 99.9 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 99.7 | 98.3 | 99.7 |
| 481 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Table 16. The percentage of time water levels are above specific elevations at the Corps of Engineers gage at Waverly on the Missouri River from 1931 through 1993 using dataset B.

| Elev. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 676 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 675 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 674 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 1.1 | 0.1 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 |
| 673 | 0.0 | 0.0 | 0.0 | 0.1 | 0.2 | 0.2 | 1.4 | 0.2 | 0.1 | 0.2 | 0.0 | 0.0 | 0.2 |
| 672 | 0.0 | 0.0 | 0.0 | 0.2 | 0.3 | 0.7 | 1.9 | 0.2 | 0.2 | 0.3 | 0.0 | 0.0 | 0.3 |
| 671 | 0.0 | 0.0 | 0.0 | 0.6 | 0.5 | 1.1 | 2.3 | 0.3 | 0.3 | 0.5 | 0.0 | 0.0 | 0.5 |
| 670 | 0.0 | 0.0 | 0.1 | 1.0 | 0.7 | 2.0 | 2.7 | 0.4 | 0.4 | 0.5 | 0.0 | 0.0 | 0.7 |
| 669 | 0.0 | 0.0 | 0.2 | 1.7 | 1.1 | 2.6 | 3.5 | 0.6 | 0.6 | 0.9 | 0.0 | 0.0 | 0.9 |
| 668 | 0.0 | 0.0 | 0.5 | 2.6 | 1.6 | 3.0 | 4.1 | 0.8 | 0.9 | 1.2 | 0.0 | 0.0 | 1.2 |
| 667 | 0.0 | 0.0 | 1.2 | 4.0 | 2.5 | 4.6 | 5.0 | 1.2 | 1.4 | 1.5 | 0.0 | 0.0 | 1.8 |
| 666 | 0.0 | 0.0 | 2.0 | 5.8 | 4.0 | 6.7 | 5.8 | 1.8 | 2.2 | 1.9 | 0.1 | 0.1 | 2.6 |
| 665 | 0.1 | 0.1 | 2.9 | 8.0 | 5.6 | 9.4 | 7.3 | 2.2 | 3.3 | 2.7 | 0.2 | 0.2 | 3.5 |
| 664 | 0.4 | 0.1 | 4.3 | 11.7 | 7.9 | 13.5 | 9.6 | 2.9 | 4.5 | 3.3 | 0.4 | 0.3 | 5.0 |
| 663 | 0.4 | 0.4 | 6.1 | 14.8 | 11.1 | 17.8 | 12.3 | 4.1 | 5.3 | 4.0 | 1.1 | 0.4 | 6.5 |
| 662 | 0.6 | 0.7 | 8.2 | 18.8 | 15.3 | 23.4 | 16.3 | 5.2 | 6.7 | 5.0 | 2.0 | 0.7 | 8.7 |
| 661 | 1.3 | 1.3 | 11.9 | 23.3 | 19.7 | 30.4 | 22.2 | 7.0 | 8.9 | 6.5 | 3.6 | 1.3 | 11.6 |
| 660 | 2.0 | 2.6 | 14.9 | 28.5 | 27.1 | 39.3 | 29.6 | 11.8 | 11.8 | 8.5 | 6.3 | 2.5 | 15.5 |
| 659 | 2.6 | 4.8 | 17.5 | 32.4 | 35.6 | 50.4 | 40.0 | 20.1 | 18.8 | 13.0 | 12.5 | 3.9 | 21.2 |
| 658 | 4.3 | 9.0 | 23.5 | 38.9 | 43.6 | 62.1 | 47.9 | 28.8 | 25.9 | 20.3 | 20.5 | 6.0 | 27.8 |
| 657 | 6.3 | 12.5 | 31.1 | 47.9 | 52.7 | 72.0 | 58.2 | 39.8 | 35.5 | 30.9 | 27.3 | 11.1 | 35.7 |
| 656 | 9.3 | 19.0 | 40.0 | 61.2 | 65.2 | 82.8 | 75.6 | 52.6 | 47.6 | 41.9 | 34.1 | 16.9 | 45.9 |

Table 16. Continued.

| Elev. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 655 | 13.8 | 25.2 | 50.5 | 74.9 | 77.4 | 93.3 | 87.8 | 71.1 | 66.0 | 59.2 | 44.7 | 21.1 | 57.5 |
| 654 | 20.0 | 33.3 | 63.0 | 86.8 | 88.3 | 96.8 | 94.8 | 83.3 | 79.5 | 74.2 | 56.4 | 26.7 | 67.4 |
| 653 | 28.1 | 49.7 | 74.3 | 92.4 | 95.0 | 98.6 | 97.4 | 88.7 | 85.6 | 79.4 | 64.1 | 34.7 | 74.4 |
| 652 | 42.9 | 64.5 | 85.0 | 97.1 | 98.8 | 99.6 | 98.3 | 93.6 | 90.4 | 85.0 | 74.7 | 47.7 | 81.8 |
| 651 | 60.6 | 77.4 | 92.7 | 99.4 | 100.0 | 100.0 | 99.6 | 96.1 | 93.6 | 87.2 | 83.8 | 63.4 | 88.0 |
| 650 | 77.7 | 89.6 | 97.2 | 99.9 | 100.0 | 100.0 | 100.0 | 97.7 | 96.3 | 92.4 | 91.1 | 77.9 | 93.4 |
| 649 | 88.6 | 96.8 | 99.8 | 100.0 | 100.0 | 100.0 | 100.0 | 99.7 | 99.2 | 98.2 | 98.7 | 89.0 | 97.5 |
| 648 | 95.3 | 99.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 99.7 | 96.3 | 99.2 |
| 647 | 99.5 | 99.9 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 99.6 | 99.9 |
| 646 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 99.8 | 100.0 |
| 645 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Table 17. The percentage of time water levels are above specific elevations at the Corps of Engineers gage at St. Joseph on the Missouri River from 1931 through 1993 using dataset B.

| Elev. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 820 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 819 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 818 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 817 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 816 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 815 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |
| 814 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |
| 813 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.4 | 1.3 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.2 |
| 812 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.5 | 1.4 | 0.1 | 0.0 | 0.2 | 0.0 | 0.0 | 0.2 |
| 811 | 0.0 | 0.0 | 0.1 | 0.5 | 0.1 | 1.0 | 1.5 | 0.2 | 0.0 | 0.2 | 0.0 | 0.0 | 0.3 |
| 810 | 0.0 | 0.0 | 0.2 | 0.6 | 0.3 | 1.0 | 1.5 | 0.2 | 0.1 | 0.3 | 0.0 | 0.0 | 0.3 |
| 809 | 0.0 | 0.1 | 0.4 | 1.1 | 0.4 | 1.5 | 1.9 | 0.2 | 0.1 | 0.4 | 0.0 | 0.0 | 0.5 |
| 808 | 0.0 | 0.2 | 0.9 | 1.8 | 1.0 | 2.5 | 2.3 | 0.3 | 0.4 | 0.4 | 0.0 | 0.0 | 0.8 |
| 807 | 0.1 | 0.2 | 1.3 | 2.8 | 2.2 | 4.1 | 3.0 | 0.4 | 0.7 | 0.6 | 0.0 | 0.0 | 1.3 |
| 806 | 0.5 | 0.6 | 1.8 | 4.4 | 3.3 | 5.9 | 3.7 | 0.5 | 1.4 | 0.7 | 0.0 | 0.0 | 1.9 |
| 805 | 1.3 | 1.3 | 2.8 | 6.9 | 4.5 | 8.9 | 5.0 | 0.8 | 2.2 | 1.1 | 0.1 | 0.0 | 2.9 |
| 804 | 2.5 | 2.1 | 4.1 | 10.2 | 6.8 | 12.5 | 7.6 | 1.5 | 3.3 | 1.8 | 0.1 | 0.6 | 4.4 |
| 803 | 3.7 | 3.2 | 6.3 | 13.6 | 9.2 | 19.0 | 11.5 | 3.9 | 5.4 | 3.3 | 1.4 | 1.5 | 6.8 |
| 802 | 4.7 | 4.6 | 8.7 | 18.4 | 14.2 | 27.3 | 17.6 | 8.4 | 8.5 | 6.1 | 5.6 | 2.3 | 10.5 |
| 801 | 5.6 | 6.7 | 12.2 | 23.3 | 22.7 | 39.1 | 27.1 | 15.5 | 13.2 | 11.3 | 9.2 | 3.4 | 15.8 |
| 800 | 6.9 | 8.7 | 16.6 | 32.0 | 32.1 | 51.5 | 40.1 | 24.1 | 20.8 | 18.5 | 14.0 | 4.6 | 22.5 |

Table 17. Continued.

| Elev. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 799 | 9.2 | 10.7 | 24.0 | 42.8 | 45.4 | 68.8 | 54.8 | 35.8 | 31.8 | 26.8 | 21.2 | 6.6 | 31.5 |
| 798 | 11.5 | 14.0 | 35.1 | 61.8 | 65.6 | 88.3 | 81.6 | 64.3 | 60.2 | 50.2 | 35.9 | 9.9 | 48.2 |
| 797 | 15.7 | 21.8 | 49.5 | 79.9 | 81.5 | 95.9 | 92.3 | 76.0 | 71.9 | 66.9 | 49.9 | 15.3 | 59.8 |
| 796 | 20.6 | 34.0 | 63.6 | 88.5 | 89.0 | 98.5 | 95.8 | 84.2 | 80.8 | 76.3 | 55.9 | 23.3 | 67.6 |
| 795 | 29.7 | 52.8 | 79.4 | 96.4 | 96.4 | 99.6 | 97.5 | 89.0 | 85.9 | 83.2 | 69.4 | 33.7 | 76.1 |
| 794 | 50.7 | 72.9 | 91.3 | 99.4 | 99.5 | 99.8 | 98.8 | 93.7 | 89.6 | 86.5 | 79.6 | 53.2 | 84.6 |
| 793 | 72.0 | 88.0 | 96.6 | 100.0 | 100.0 | 100.0 | 99.7 | 96.5 | 92.7 | 90.1 | 85.9 | 67.7 | 90.8 |
| 792 | 84.6 | 94.0 | 99.1 | 100.0 | 100.0 | 100.0 | 100.0 | 99.0 | 96.8 | 92.9 | 92.2 | 78.2 | 94.7 |
| 791 | 91.8 | 97.3 | 99.8 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 99.5 | 98.5 | 98.8 | 88.9 | 97.9 |
| 790 | 97.4 | 99.6 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 99.8 | 95.1 | 99.3 |
| 789 | 99.9 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 99.2 | 99.9 |
| 788 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Table 18. The percentage of time water levels are above specific elevations at the Corps of Engineers gage at Omaha on the Missouri River from 1929 through 1993. Numerous values are suspected of being incorrect in this dataset.

| Elev. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 980 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 979 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 978 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 977 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.1 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |
| 976 | 0.0 | 0.0 | 0.1 | 1.0 | 0.0 | 1.0 | 1.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 |
| 975 | 0.0 | 0.0 | 0.1 | 1.3 | 0.2 | 2.0 | 1.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 |
| 974 | 0.0 | 0.0 | 0.3 | 1.7 | 0.3 | 2.8 | 2.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 |
| 973 | 0.0 | 0.0 | 0.4 | 2.2 | 0.4 | 4.4 | 3.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.9 |
| 972 | 0.2 | 0.0 | 1.0 | 2.6 | 0.8 | 6.1 | 4.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.2 |
| 971 | 0.5 | 0.0 | 1.6 | 3.6 | 1.5 | 8.9 | 6.3 | 1.2 | 0.6 | 0.0 | 0.0 | 0.1 | 2.0 |
| 970 | 0.6 | 0.1 | 3.0 | 5.2 | 2.9 | 14.2 | 10.6 | 1.6 | 1.5 | 0.2 | 0.0 | 0.1 | 3.4 |
| 969 | 0.7 | 0.1 | 5.3 | 7.9 | 5.3 | 22.0 | 17.1 | 4.7 | 3.8 | 2.2 | 0.2 | 0.1 | 5.8 |
| 968 | 1.0 | 0.3 | 8.1 | 13.8 | 10.4 | 31.3 | 26.5 | 9.9 | 9.5 | 5.3 | 1.8 | 0.1 | 9.9 |
| 967 | 1.3 | 1.1 | 11.6 | 22.9 | 22.8 | 44.5 | 43.7 | 22.2 | 16.4 | 10.0 | 6.1 | 0.4 | 17.1 |
| 966 | 1.9 | 3.6 | 19.1 | 35.1 | 42.6 | 61.9 | 62.1 | 40.5 | 31.3 | 21.1 | 11.2 | 1.4 | 27.9 |
| 965 | 4.1 | 9.2 | 30.6 | 58.7 | 67.8 | 79.2 | 78.7 | 64.3 | 54.0 | 39.1 | 21.8 | 3.0 | 42.9 |
| 964 | 9.8 | 18.0 | 43.0 | 74.7 | 79.8 | 87.4 | 90.4 | 84.7 | 75.8 | 64.4 | 44.3 | 6.8 | 57.0 |
| 963 | 19.9 | 32.1 | 59.5 | 87.1 | 92.7 | 95.9 | 98.3 | 96.5 | 91.4 | 85.1 | 63.2 | 14.6 | 70.0 |
| 962 | 39.4 | 49.1 | 71.5 | 94.4 | 98.1 | 96.4 | 98.6 | 98.7 | 97.3 | 95.4 | 73.5 | 37.7 | 79.5 |
| 961 | 62.5 | 68.1 | 80.4 | 96.9 | 98.3 | 96.7 | 99.0 | 99.3 | 99.6 | 98.4 | 79.4 | 62.0 | 86.9 |
| 960 | 76.3 | 81.4 | 88.8 | 97.4 | 98.5 | 97.4 | 99.1 | 99.3 | 99.6 | 99.2 | 85.0 | 73.0 | 91.4 |

**Table 18. Continued.**

| Elev. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 959 | 91.2 | 91.5 | 94.8 | 98.6 | 99.1 | 98.6 | 99.5 | 99.7 | 99.9 | 100.0 | 93.0 | 84.6 | 95.9 |
| 958 | 99.3 | 99.4 | 98.2 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 96.6 | 97.9 | 99.3 |
| 957 | 99.8 | 99.8 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 99.9 | 99.8 | 99.9 |
| 956 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

**Table 19.** The percentage of time water levels are above specific elevations at the Corps of Engineers gage at Hermann on the Missouri River from 1964 through 1993 using dataset B.

| Elev. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 517 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 516 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.2 | 0.0 | 0.2 | 0.0 | 0.0 | 0.1 |
| 515 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.6 | 0.3 | 0.0 | 0.3 | 0.0 | 0.0 | 0.1 |
| 514 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 1.1 | 0.4 | 0.0 | 0.4 | 0.0 | 0.0 | 0.2 |
| 513 | 0.0 | 0.3 | 0.0 | 1.0 | 0.4 | 0.0 | 1.3 | 0.5 | 0.1 | 0.5 | 0.0 | 0.0 | 0.4 |
| 512 | 0.0 | 0.5 | 0.2 | 1.6 | 0.6 | 0.0 | 1.8 | 0.6 | 0.4 | 0.9 | 0.0 | 0.2 | 0.6 |
| 511 | 0.0 | 0.6 | 1.5 | 2.1 | 0.8 | 0.2 | 2.7 | 0.9 | 0.9 | 1.0 | 0.0 | 0.4 | 0.9 |
| 510 | 0.0 | 0.6 | 2.1 | 2.9 | 0.9 | 0.4 | 2.8 | 1.2 | 0.9 | 1.2 | 0.0 | 0.5 | 1.1 |
| 509 | 0.0 | 0.6 | 2.6 | 3.9 | 1.4 | 1.2 | 3.3 | 1.4 | 0.9 | 2.0 | 0.2 | 0.7 | 1.5 |
| 508 | 0.0 | 0.6 | 3.0 | 4.7 | 2.5 | 3.1 | 4.1 | 1.7 | 1.4 | 2.8 | 0.7 | 0.8 | 2.1 |
| 507 | 0.0 | 0.7 | 3.7 | 6.2 | 3.8 | 4.8 | 5.3 | 1.8 | 1.8 | 3.9 | 0.8 | 1.2 | 2.8 |
| 506 | 0.1 | 0.7 | 4.7 | 8.4 | 5.6 | 6.0 | 6.3 | 2.0 | 2.3 | 4.7 | 0.8 | 1.3 | 3.6 |
| 505 | 0.1 | 0.8 | 6.8 | 10.0 | 7.6 | 7.8 | 7.1 | 2.3 | 3.2 | 5.5 | 1.3 | 1.5 | 4.5 |
| 504 | 0.4 | 1.0 | 8.5 | 13.0 | 10.9 | 9.7 | 8.3 | 2.4 | 3.6 | 6.4 | 2.0 | 2.1 | 5.7 |
| 503 | 0.9 | 1.8 | 10.4 | 15.4 | 13.6 | 12.1 | 9.7 | 3.0 | 4.8 | 7.0 | 2.3 | 2.2 | 7.0 |
| 502 | 1.1 | 2.1 | 12.0 | 18.3 | 16.1 | 14.5 | 10.9 | 3.4 | 5.5 | 7.4 | 3.8 | 2.9 | 8.2 |
| 501 | 1.1 | 3.0 | 13.6 | 22.3 | 19.2 | 17.7 | 11.9 | 4.1 | 6.7 | 8.1 | 5.3 | 4.0 | 9.8 |
| 500 | 1.5 | 4.5 | 16.2 | 26.2 | 23.1 | 23.2 | 13.9 | 4.7 | 7.7 | 9.4 | 7.6 | 5.4 | 12.0 |
| 499 | 2.6 | 7.0 | 19.4 | 31.8 | 27.3 | 28.8 | 16.9 | 5.4 | 9.7 | 11.6 | 10.1 | 6.5 | 14.8 |
| 498 | 3.2 | 9.6 | 22.5 | 36.9 | 31.1 | 35.5 | 21.4 | 6.6 | 11.2 | 13.9 | 13.2 | 8.4 | 17.8 |
| 497 | 4.3 | 11.6 | 26.7 | 40.7 | 38.5 | 41.5 | 25.4 | 7.4 | 12.7 | 15.9 | 16.3 | 10.7 | 21.0 |

Table 19. Continued.

| Elev. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 496 | 4.8 | 15.0 | 30.9 | 46.4 | 46.2 | 48.8 | 30.3 | 9.0 | 15.8 | 18.7 | 20.6 | 15.2 | 25.2 |
| 495 | 6.3 | 17.6 | 37.4 | 51.0 | 52.5 | 53.4 | 37.3 | 13.1 | 18.8 | 20.6 | 24.8 | 18.2 | 29.3 |
| 494 | 8.9 | 22.3 | 43.6 | 57.9 | 58.0 | 61.0 | 43.1 | 18.1 | 24.3 | 23.4 | 30.2 | 21.6 | 34.4 |
| 493 | 12.3 | 27.6 | 49.7 | 65.3 | 63.8 | 69.2 | 49.2 | 26.6 | 30.3 | 26.7 | 37.0 | 27.4 | 40.4 |
| 492 | 16.8 | 34.7 | 55.5 | 72.1 | 68.4 | 75.9 | 58.7 | 40.6 | 38.4 | 33.5 | 44.9 | 33.4 | 47.8 |
| 491 | 23.2 | 40.2 | 60.7 | 78.4 | 74.8 | 83.1 | 66.7 | 58.0 | 52.6 | 45.6 | 58.4 | 39.8 | 56.8 |
| 490 | 29.5 | 45.6 | 68.9 | 85.6 | 87.6 | 89.9 | 77.3 | 73.2 | 66.9 | 57.8 | 67.8 | 49.0 | 66.6 |
| 489 | 37.4 | 52.5 | 75.8 | 91.9 | 94.0 | 93.4 | 87.3 | 82.0 | 79.8 | 68.1 | 72.7 | 56.9 | 74.4 |
| 488 | 46.7 | 62.0 | 80.9 | 95.3 | 97.1 | 97.9 | 95.3 | 91.5 | 88.6 | 85.4 | 83.9 | 67.0 | 82.7 |
| 487 | 56.3 | 72.5 | 85.6 | 99.4 | 99.2 | 99.9 | 99.7 | 96.2 | 97.8 | 97.4 | 91.7 | 76.4 | 89.4 |
| 486 | 67.0 | 80.2 | 90.6 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 93.1 | 82.7 | 92.8 |
| 485 | 78.8 | 88.0 | 95.6 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 94.5 | 91.0 | 95.7 |
| 484 | 91.3 | 96.9 | 99.8 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 96.9 | 95.0 | 98.3 |
| 483 | 97.6 | 99.5 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 98.6 | 99.6 |
| 482 | 99.9 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 99.7 | 100.0 |
| 481 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

**Table 20.** The percentage of time water levels are above specific elevations at the Corps of Engineers gage at Waverly on the Missouri River from 1964 through 1993 using dataset B.

| Elev. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 676 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 675 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |
| 674 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.2 | 2.4 | 0.2 | 0.0 | 0.1 | 0.0 | 0.0 | 0.3 |
| 673 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.5 | 2.7 | 0.3 | 0.1 | 0.4 | 0.0 | 0.0 | 0.4 |
| 672 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 1.4 | 3.0 | 0.5 | 0.5 | 0.6 | 0.0 | 0.0 | 0.5 |
| 671 | 0.0 | 0.0 | 0.0 | 0.2 | 1.0 | 2.0 | 3.3 | 0.7 | 0.6 | 1.0 | 0.0 | 0.0 | 0.8 |
| 670 | 0.0 | 0.0 | 0.0 | 0.5 | 1.6 | 2.9 | 4.1 | 0.9 | 0.8 | 1.1 | 0.0 | 0.0 | 1.0 |
| 669 | 0.0 | 0.0 | 0.2 | 1.0 | 2.2 | 3.1 | 4.9 | 1.2 | 1.3 | 1.9 | 0.0 | 0.0 | 1.4 |
| 668 | 0.0 | 0.0 | 0.8 | 2.3 | 3.1 | 3.5 | 5.7 | 1.7 | 1.8 | 2.5 | 0.0 | 0.0 | 1.8 |
| 667 | 0.0 | 0.0 | 2.4 | 4.3 | 4.9 | 4.9 | 6.7 | 2.4 | 2.6 | 3.1 | 0.0 | 0.0 | 2.7 |
| 666 | 0.0 | 0.0 | 3.7 | 7.4 | 7.7 | 6.2 | 7.8 | 3.5 | 3.9 | 3.9 | 0.1 | 0.2 | 3.8 |
| 665 | 0.1 | 0.1 | 5.1 | 11.4 | 10.1 | 9.7 | 10.2 | 4.2 | 5.6 | 5.6 | 0.4 | 0.4 | 5.3 |
| 664 | 0.7 | 0.1 | 7.7 | 15.8 | 13.8 | 14.6 | 12.6 | 4.7 | 7.6 | 7.0 | 0.9 | 0.7 | 7.3 |
| 663 | 1.3 | 0.9 | 11.4 | 19.9 | 17.5 | 19.3 | 16.3 | 6.2 | 9.1 | 8.3 | 2.2 | 0.8 | 9.6 |
| 662 | 1.3 | 1.4 | 14.4 | 25.3 | 24.1 | 25.5 | 20.2 | 7.9 | 11.8 | 10.1 | 4.0 | 1.4 | 12.5 |
| 661 | 2.0 | 2.9 | 19.5 | 31.3 | 30.3 | 33.8 | 26.7 | 11.0 | 15.5 | 12.7 | 6.9 | 2.7 | 16.5 |
| 660 | 2.9 | 5.2 | 22.7 | 37.9 | 40.5 | 45.1 | 34.8 | 20.2 | 21.1 | 16.2 | 12.4 | 5.3 | 22.3 |
| 659 | 4.3 | 9.8 | 26.6 | 41.7 | 52.5 | 58.2 | 47.0 | 35.5 | 33.6 | 24.9 | 25.1 | 8.3 | 31.0 |
| 658 | 7.6 | 17.6 | 34.3 | 49.3 | 59.5 | 72.2 | 53.8 | 49.8 | 45.9 | 37.9 | 41.0 | 13.0 | 40.5 |
| 657 | 11.8 | 22.8 | 44.0 | 61.3 | 70.6 | 82.2 | 65.2 | 67.1 | 62.2 | 57.1 | 53.2 | 24.1 | 52.3 |
| 656 | 19.5 | 32.8 | 55.3 | 79.8 | 85.9 | 92.6 | 88.3 | 81.2 | 79.4 | 75.5 | 64.8 | 36.3 | 66.5 |

Table 20. Continued.

| Elev. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 655 | 28.8 | 44.1 | 68.2 | 97.0 | 97.0 | 99.8 | 99.7 | 99.4 | 99.4 | 96.6 | 80.5 | 44.4 | 80.2 |
| 654 | 39.8 | 54.7 | 79.0 | 99.8 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 88.4 | 54.3 | 85.2 |
| 653 | 53.1 | 73.5 | 86.8 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 91.2 | 68.5 | 89.8 |
| 652 | 76.7 | 89.7 | 95.8 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 94.8 | 84.6 | 95.3 |
| 651 | 89.7 | 92.8 | 97.1 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 99.9 | 95.8 | 98.0 |
| 650 | 96.3 | 98.3 | 98.7 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 99.4 | 99.4 |
| 649 | 99.3 | 99.2 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 99.4 | 99.8 |
| 648 | 100.0 | 99.6 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 99.4 | 99.9 |
| 647 | 100.0 | 99.9 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 99.6 | 100.0 |
| 646 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 99.6 | 100.0 |
| 645 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Table 21. The percentage of time water levels are above specific elevations at the Corps of Engineers gage at St. Joseph on the Missouri River from 1964 through 1993 using dataset B.

| Elev. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 820 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 819 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 818 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 817 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |
| 816 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |
| 815 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |
| 814 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 |
| 813 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 2.8 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.3 |
| 812 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 3.0 | 0.2 | 0.0 | 0.3 | 0.0 | 0.0 | 0.4 |
| 811 | 0.0 | 0.0 | 0.1 | 0.0 | 0.1 | 2.0 | 3.1 | 0.3 | 0.0 | 0.3 | 0.0 | 0.0 | 0.5 |
| 810 | 0.0 | 0.0 | 0.3 | 0.0 | 0.5 | 2.1 | 3.2 | 0.3 | 0.1 | 0.5 | 0.0 | 0.0 | 0.6 |
| 809 | 0.0 | 0.1 | 0.9 | 0.1 | 0.9 | 3.1 | 4.1 | 0.4 | 0.2 | 0.8 | 0.0 | 0.0 | 0.9 |
| 808 | 0.0 | 0.3 | 1.8 | 1.0 | 2.2 | 4.8 | 4.7 | 0.7 | 0.8 | 0.9 | 0.0 | 0.0 | 1.4 |
| 807 | 0.1 | 0.5 | 2.4 | 2.4 | 4.4 | 6.6 | 5.4 | 0.8 | 1.5 | 1.2 | 0.0 | 0.0 | 2.1 |
| 806 | 1.0 | 1.2 | 3.1 | 4.3 | 6.1 | 9.0 | 6.6 | 1.1 | 3.1 | 1.4 | 0.0 | 0.0 | 3.1 |
| 805 | 2.8 | 2.3 | 4.3 | 7.6 | 8.3 | 12.3 | 8.0 | 1.6 | 4.5 | 2.3 | 0.1 | 0.0 | 4.5 |
| 804 | 5.0 | 3.3 | 6.3 | 11.5 | 12.1 | 15.7 | 11.3 | 2.8 | 6.8 | 3.8 | 0.1 | 1.2 | 6.7 |
| 803 | 7.0 | 5.4 | 9.8 | 15.5 | 15.8 | 22.8 | 16.7 | 7.3 | 11.0 | 7.0 | 2.9 | 3.2 | 10.3 |
| 802 | 8.8 | 7.9 | 13.0 | 21.8 | 24.4 | 32.7 | 24.9 | 15.3 | 16.7 | 12.6 | 11.7 | 4.8 | 16.2 |
| 801 | 10.5 | 10.7 | 17.0 | 29.0 | 37.9 | 47.2 | 36.1 | 28.6 | 25.9 | 23.5 | 19.3 | 7.2 | 24.4 |
| 800 | 13.0 | 14.5 | 21.6 | 41.4 | 50.9 | 60.6 | 47.5 | 43.4 | 39.3 | 37.5 | 29.5 | 9.7 | 34.0 |

Table 21. Continued.

| Elev. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 799 | 17.6 | 17.2 | 30.8 | 56.0 | 67.4 | 76.8 | 64.6 | 60.2 | 57.0 | 51.6 | 44.2 | 14.0 | 46.4 |
| 798 | 21.9 | 21.3 | 46.2 | 83.4 | 90.8 | 93.4 | 90.0 | 87.9 | 87.6 | 80.4 | 69.4 | 20.8 | 66.1 |
| 797 | 29.9 | 32.5 | 62.8 | 93.4 | 99.3 | 100.0 | 98.8 | 95.5 | 98.5 | 94.4 | 81.9 | 31.5 | 76.5 |
| 796 | 38.2 | 41.2 | 73.1 | 99.4 | 100.0 | 100.0 | 100.0 | 100.0 | 99.9 | 99.4 | 84.4 | 47.1 | 81.9 |
| 795 | 49.6 | 62.2 | 81.4 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 87.2 | 64.7 | 87.1 |
| 794 | 70.9 | 83.5 | 90.9 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 90.4 | 81.6 | 93.1 |
| 793 | 88.9 | 96.0 | 98.2 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 93.0 | 89.9 | 97.1 |
| 792 | 98.7 | 99.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 97.2 | 94.9 | 99.1 |
| 791 | 99.8 | 99.5 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 98.6 | 99.8 |
| 790 | 100.0 | 99.8 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 99.2 | 99.9 |
| 789 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 99.6 | 100.0 |
| 788 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Table 22. The percentage of time water levels are above specific elevations at the Corps of Engineers gage at Omaha on the Missouri River from 1964 through 1993. Numerous values are suspected of being incorrect in this dataset.

| Elev. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 978 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 977 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 976 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.9 | 1.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 |
| 975 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.6 | 1.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 |
| 974 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 1.7 | 1.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 |
| 973 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 2.3 | 2.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 |
| 972 | 0.4 | 0.0 | 0.0 | 0.9 | 0.0 | 3.1 | 2.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 |
| 971 | 1.0 | 0.0 | 0.2 | 2.2 | 0.9 | 4.9 | 3.4 | 2.5 | 1.2 | 0.0 | 0.0 | 0.1 | 1.4 |
| 970 | 1.3 | 0.1 | 1.1 | 3.8 | 3.0 | 6.9 | 7.9 | 3.5 | 2.9 | 0.4 | 0.0 | 0.1 | 2.6 |
| 969 | 1.4 | 0.2 | 2.4 | 6.7 | 5.9 | 13.7 | 15.1 | 9.1 | 7.9 | 4.8 | 0.3 | 0.1 | 5.7 |
| 968 | 2.1 | 0.6 | 3.6 | 11.8 | 12.9 | 20.8 | 26.4 | 19.2 | 19.2 | 11.6 | 3.9 | 0.1 | 11.1 |
| 967 | 2.9 | 1.5 | 5.6 | 19.9 | 28.1 | 36.5 | 45.0 | 39.0 | 31.9 | 21.9 | 13.4 | 0.8 | 20.6 |
| 966 | 3.6 | 2.7 | 11.6 | 30.1 | 52.9 | 62.1 | 71.0 | 61.2 | 57.0 | 42.0 | 24.7 | 2.9 | 35.3 |
| 965 | 4.9 | 5.0 | 21.8 | 65.4 | 83.5 | 91.2 | 92.7 | 88.6 | 88.3 | 68.7 | 41.6 | 5.6 | 55.0 |
| 964 | 8.4 | 8.4 | 37.3 | 88.9 | 96.2 | 97.8 | 99.6 | 99.2 | 97.2 | 93.6 | 70.5 | 11.2 | 67.6 |
| 963 | 14.8 | 20.6 | 57.0 | 97.0 | 99.9 | 98.1 | 100.0 | 100.0 | 100.0 | 98.1 | 78.8 | 20.5 | 74.0 |
| 962 | 33.6 | 41.5 | 70.7 | 99.3 | 100.0 | 98.1 | 100.0 | 100.0 | 100.0 | 98.7 | 80.9 | 43.4 | 80.7 |
| 961 | 61.8 | 67.9 | 81.6 | 99.3 | 100.0 | 98.3 | 100.0 | 100.0 | 100.0 | 99.2 | 82.5 | 71.8 | 88.6 |
| 960 | 79.0 | 82.8 | 88.7 | 99.3 | 100.0 | 98.6 | 100.0 | 100.0 | 100.0 | 99.8 | 85.5 | 83.0 | 93.1 |
| 959 | 93.5 | 93.3 | 93.1 | 99.9 | 100.0 | 99.1 | 100.0 | 100.0 | 100.0 | 100.0 | 90.3 | 90.3 | 96.7 |
| 958 | 98.5 | 98.7 | 96.1 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 92.4 | 95.6 | 98.5 |

Table 22. Continued.

| Elev. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 957 | 99.7 | 99.6 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 99.8 | 99.6 | 99.9 |
| 956 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

**Table 23.** Year, number of observations, and the R-square value from the yearly regression equations of water surface elevations versus discharge at Hermann, Missouri.

| Year | Number of observations | R-square |
|---|---|---|
| 1931 | 361 | 0.99147 |
| 1932 | 361 | 0.98905 |
| 1933 | 361 | 0.99536 |
| 1934 | 360 | 0.98234 |
| 1935 | 361 | 0.99494 |
| 1936 | 314 | 0.99127 |
| 1937 | 361 | 0.97884 |
| 1938 | 361 | 0.99323 |
| 1939 | 361 | 0.99471 |
| 1940 | 302 | 0.99247 |
| 1941 | 361 | 0.99413 |
| 1942 | 358 | 0.98990 |
| 1943 | 361 | 0.99374 |
| 1944 | 362 | 0.99329 |
| 1945 | 361 | 0.98119 |
| 1946 | 356 | 0.97996 |
| 1947 | 361 | 0.99276 |
| 1948 | 303 | 0.98526 |
| 1949 | 360 | 0.99019 |
| 1950 | 360 | 0.99165 |
| 1951 | 357 | 0.96409 |
| 1952 | 361 | 0.99472 |
| 1953 | 361 | 0.99289 |
| 1954 | 361 | 0.98666 |
| 1955 | 356 | 0.98366 |
| 1956 | 362 | 0.98762 |
| 1957 | 359 | 0.99320 |
| 1958 | 359 | 0.98714 |
| 1959 | 360 | 0.98844 |
| 1960 | 362 | 0.99298 |
| 1961 | 361 | 0.98569 |
| 1962 | 359 | 0.98837 |

**Table 23. Continued**

| Year | Number of observations | R-square |
|---|---|---|
| 1963 | 361 | 0.96302 |
| 1964 | 362 | 0.99069 |
| 1965 | 361 | 0.98343 |
| 1966 | 356 | 0.98204 |
| 1967 | 361 | 0.98028 |
| 1968 | 362 | 0.96410 |
| 1969 | 361 | 0.97737 |
| 1970 | 361 | 0.98231 |
| 1971 | 361 | 0.97489 |
| 1972 | 359 | 0.97844 |
| 1973 | 361 | 0.97940 |
| 1974 | 330 | 0.97648 |
| 1975 | 361 | 0.96641 |
| 1976 | 360 | 0.98846 |
| 1977 | 359 | 0.98480 |
| 1978 | 359 | 0.98792 |
| 1979 | 351 | 0.99462 |
| 1980 | 359 | 0.97344 |
| 1981 | 360 | 0.98709 |
| 1982 | 358 | 0.98215 |
| 1983 | 360 | 0.95799 |
| 1984 | 360 | 0.98326 |
| 1985 | 361 | 0.98743 |
| 1986 | 361 | 0.98913 |
| 1987 | 361 | 0.98752 |
| 1988 | 356 | 0.98812 |
| 1989 | 361 | 0.98839 |
| 1990 | 361 | 0.99255 |
| 1991 | 361 | 0.99293 |
| 1992 | 361 | 0.98454 |
| 1993 | 269 | 0.98084 |

**Table 24.** Year, number of observations, and the R-square value from the yearly regression equations of water surface elevations versus discharge at Waverly, Missouri.

| Year | Number of observations | R-square |
|---|---|---|
| 1931 | 361 | 0.95503 |
| 1932 | 362 | 0.98155 |
| 1933 | 361 | 0.97333 |
| 1934 | 350 | 0.96293 |
| 1935 | 360 | 0.98058 |
| 1936 | 301 | 0.97928 |
| 1937 | 335 | 0.92264 |
| 1938 | 361 | 0.98539 |
| 1939 | 361 | 0.98287 |
| 1940 | 302 | 0.98360 |
| 1941 | 361 | 0.97720 |
| 1942 | 361 | 0.96251 |
| 1943 | 295 | 0.98140 |
| 1944 | 362 | 0.98651 |
| 1945 | 361 | 0.97407 |
| 1946 | 325 | 0.92675 |
| 1947 | 361 | 0.96755 |
| 1948 | 362 | 0.96950 |
| 1949 | 360 | 0.98085 |
| 1950 | 338 | 0.94836 |
| 1951 | 316 | 0.95622 |
| 1952 | 362 | 0.98939 |
| 1953 | 361 | 0.98483 |
| 1954 | 361 | 0.95703 |
| 1955 | 340 | 0.98938 |
| 1956 | 357 | 0.98848 |
| 1957 | 340 | 0.98846 |
| 1958 | 358 | 0.97306 |
| 1959 | 361 | 0.96579 |
| 1960 | 298 | 0.9826[illegible] |
| 1961 | 334 | 0.87079 |
| 1962 | 321 | 0.92461 |

Table 24. Continued.

| Year | Number of observations | R-square |
|---|---|---|
| 1963 | 313 | 0.92736 |
| 1964 | 331 | 0.97247 |
| 1965 | 337 | 0.92026 |
| 1966 | 326 | 0.88478 |
| 1967 | 282 | 0.93474 |
| 1968 | 332 | 0.91732 |
| 1969 | 353 | 0.95239 |
| 1970 | 322 | 0.92935 |
| 1971 | 361 | 0.97469 |
| 1972 | 330 | 0.85012 |
| 1973 | 353 | 0.94685 |
| 1974 | 315 | 0.90391 |
| 1975 | 351 | 0.97596 |
| 1976 | 309 | 0.95033 |
| 1978 | 263 | 0.94772 |
| 1979 | 286 | 0.97726 |
| 1980 | 346 | 0.93870 |
| 1981 | 339 | 0.97838 |
| 1982 | 279 | 0.96343 |
| 1983 | 312 | 0.96040 |
| 1984 | 293 | 0.96432 |
| 1985 | 323 | 0.94665 |
| 1986 | 346 | 0.96681 |
| 1988 | 356 | 0.97747 |
| 1989 | 342 | 0.98405 |
| 1990 | 358 | 0.98985 |
| 1991 | 361 | 0.99370 |
| 1992 | 359 | 0.97797 |
| 1993 | 269 | 0.98744 |

**Table 25.** Year, number of observations, and the R-square value from the yearly regression equations of water surface elevations versus discharge at St. Joseph, Missouri.

| Year | Number of observations | R-square |
|---|---|---|
| 1931 | 361 | 0.917 |
| 1932 | 361 | 0.968 |
| 1933 | 361 | 0.977 |
| 1934 | 361 | 0.967 |
| 1935 | 361 | 0.974 |
| 1936 | 307 | 0.979 |
| 1937 | 361 | 0.985 |
| 1938 | 361 | 0.970 |
| 1939 | 361 | 0.973 |
| 1940 | 362 | 0.974 |
| 1941 | 361 | 0.973 |
| 1942 | 361 | 0.980 |
| 1943 | 361 | 0.985 |
| 1944 | 362 | 0.968 |
| 1945 | 361 | 0.971 |
| 1946 | 361 | 0.969 |
| 1947 | 332 | 0.958 |
| 1948 | 307 | 0.975 |
| 1949 | 290 | 0.967 |
| 1950 | 321 | 0.972 |
| 1951 | 337 | 0.969 |
| 1952 | 362 | 0.961 |
| 1953 | 361 | 0.979 |
| 1954 | 326 | 0.931 |
| 1955 | 322 | 0.951 |
| 1956 | 362 | 0.976 |
| 1957 | 361 | 0.979 |
| 1958 | 333 | 0.914 |
| 1959 | 347 | 0.940 |
| 1960 | 360 | 0.979 |
| 1961 | 334 | 0.946 |
| 1962 | 361 | 0.893 |

Table 25. Continued.

| Year | Number of observations | R-square |
|---|---|---|
| 1963 | 325 | 0.885 |
| 1964 | 362 | 0.962 |
| 1965 | 321 | 0.852 |
| 1966 | 361 | 0.861 |
| 1967 | 358 | 0.955 |
| 1968 | 301 | 0.836 |
| 1969 | 360 | 0.948 |
| 1970 | 319 | 0.844 |
| 1971 | 314 | 0.800 |
| 1972 | 340 | 0.939 |
| 1973 | 335 | 0.826 |
| 1974 | 320 | 0.965 |
| 1975 | 356 | 0.977 |
| 1976 | 360 | 0.910 |
| 1977 | 300 | 0.945 |
| 1978 | 352 | 0.982 |
| 1979 | 298 | 0.868 |
| 1980 | 353 | 0.890 |
| 1981 | 345 | 0.972 |
| 1982 | 341 | 0.789 |
| 1983 | 349 | 0.894 |
| 1984 | 293 | 0.945 |
| 1985 | 330 | 0.950 |
| 1986 | 340 | 0.969 |
| 1987 | 359 | 0.963 |
| 1988 | 356 | 0.963 |
| 1989 | 357 | 0.973 |
| 1990 | 361 | 0.987 |
| 1991 | 361 | 0.991 |
| 1992 | 362 | 0.981 |
| 1993 | 269 | 0.984 |

**Table 26.** Year, number of observations, and the R-square value from the yearly regression equations of water surface elevations versus discharge at Omaha, Nebraska.

| Year | Number of observations | R-square |
|---|---|---|
| 1929 | 235 | 0.98038 |
| 1930 | 235 | 0.96061 |
| 1931 | 235 | 0.97358 |
| 1932 | 235 | 0.97933 |
| 1933 | 235 | 0.98506 |
| 1934 | 235 | 0.99551 |
| 1935 | 235 | 0.98849 |
| 1936 | 235 | 0.99391 |
| 1937 | 235 | 0.98662 |
| 1938 | 235 | 0.98454 |
| 1939 | 235 | 0.99146 |
| 1940 | 235 | 0.95572 |
| 1941 | 235 | 0.96753 |
| 1942 | 235 | 0.97819 |
| 1943 | 235 | 0.98144 |
| 1944 | 235 | 0.99297 |
| 1945 | 235 | 0.93858 |
| 1946 | 235 | 0.92988 |
| 1947 | 235 | 0.96869 |
| 1948 | 235 | 0.95101 |
| 1949 | 235 | 0.31022 |
| 1950 | 235 | 0.14618 |
| 1951 | 234 | 0.47066 |
| 1952 | 235 | 0.02907 |
| 1953 | 235 | 0.55868 |
| 1954 | 235 | 0.87947 |
| 1955 | 235 | 0.94794 |
| 1956 | 235 | 0.79445 |

Table 26. Continued.

| Year | Number of observations | R-square |
|---|---|---|
| 1957 | 234 | 0.96208 |
| 1958 | 235 | 0.94694 |
| 1959 | 235 | 0.86373 |
| 1960 | 235 | 0.56909 |
| 1961 | 235 | 0.96939 |
| 1962 | 235 | 0.54237 |
| 1963 | 235 | 0.47429 |
| 1964 | 235 | 0.19734 |
| 1965 | 235 | 0.58332 |
| 1966 | 235 | 0.31622 |
| 1967 | 235 | 0.50952 |
| 1968 | 235 | 0.52879 |
| 1969 | 235 | 0.87598 |
| 1970 | 230 | 0.24580 |
| 1971 | 235 | 0.67666 |
| 1972 | 226 | 0.34773 |
| 1973 | 235 | 0.47695 |
| 1974 | 235 | 0.32750 |
| 1975 | 234 | 0.82030 |
| 1976 | 211 | 0.39583 |
| 1977 | 200 | 0.29255 |
| 1978 | 209 | 0.76719 |
| 1979 | 235 | 0.12234 |
| 1980 | 235 | 0.16221 |
| 1981 | 234 | 0.91918 |
| 1982 | 231 | 0.60008 |
| 1983 | 234 | 0.70239 |
| 1984 | 235 | 0.82155 |
| 1985 | 235 | 0.74223 |

Table 26. Continued.

| Year | Number of observations | R-square |
|---|---|---|
| 1987 | 235 | 0.82505 |
| 1988 | 235 | 0.94112 |
| 1989 | 179 | 0.92200 |
| 1990 | 52 | 0.99952 |
| 1991 | 231 | 0.99626 |
| 1992 | 235 | 0.99033 |
| 1993 | 179 | 0.98219 |

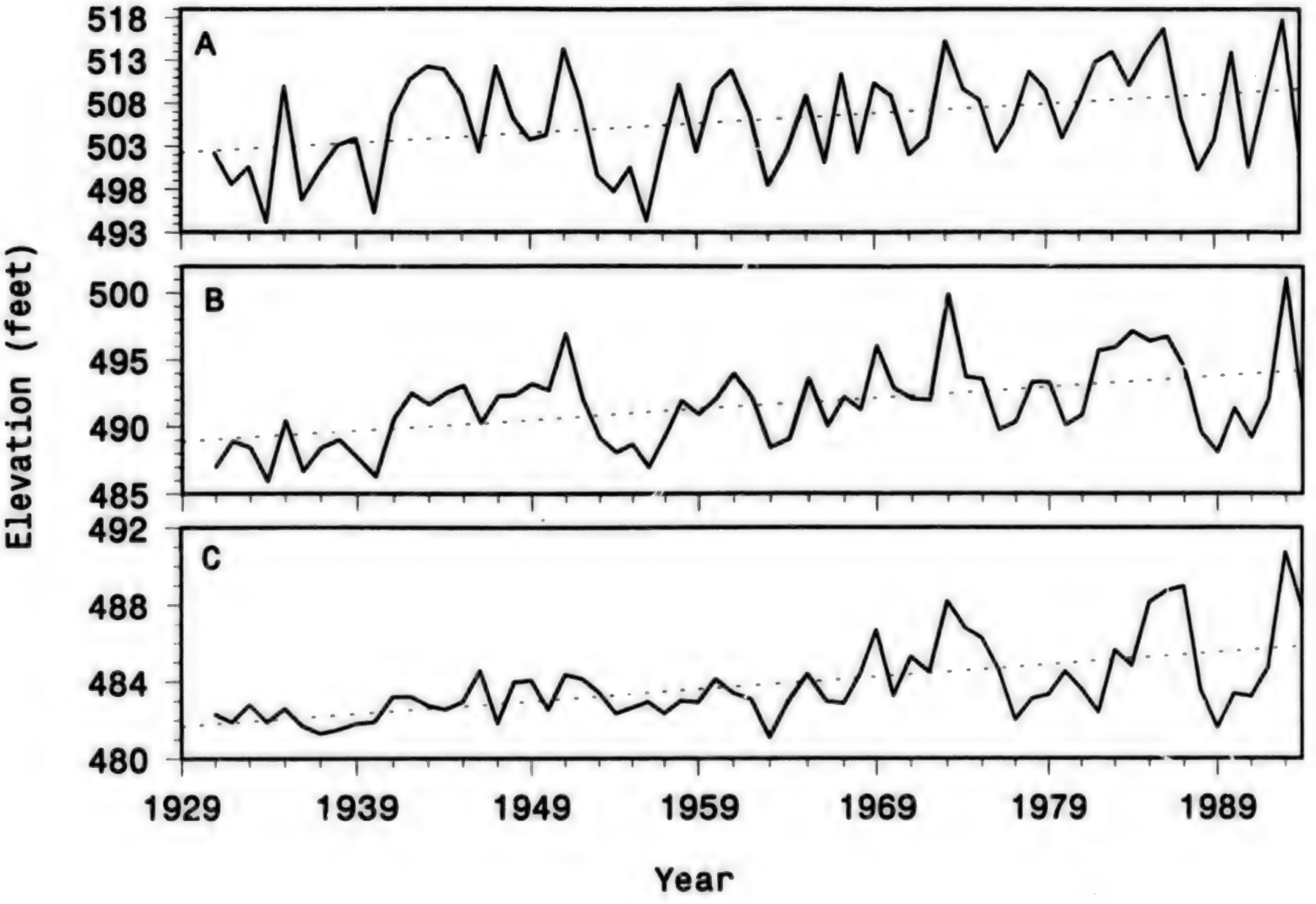

**Figure 1.** The maximum (A), yearly mean (B), and minimum (C) water level elevations at Hermann, Missouri, between 1931 and 1993 using dataset A.

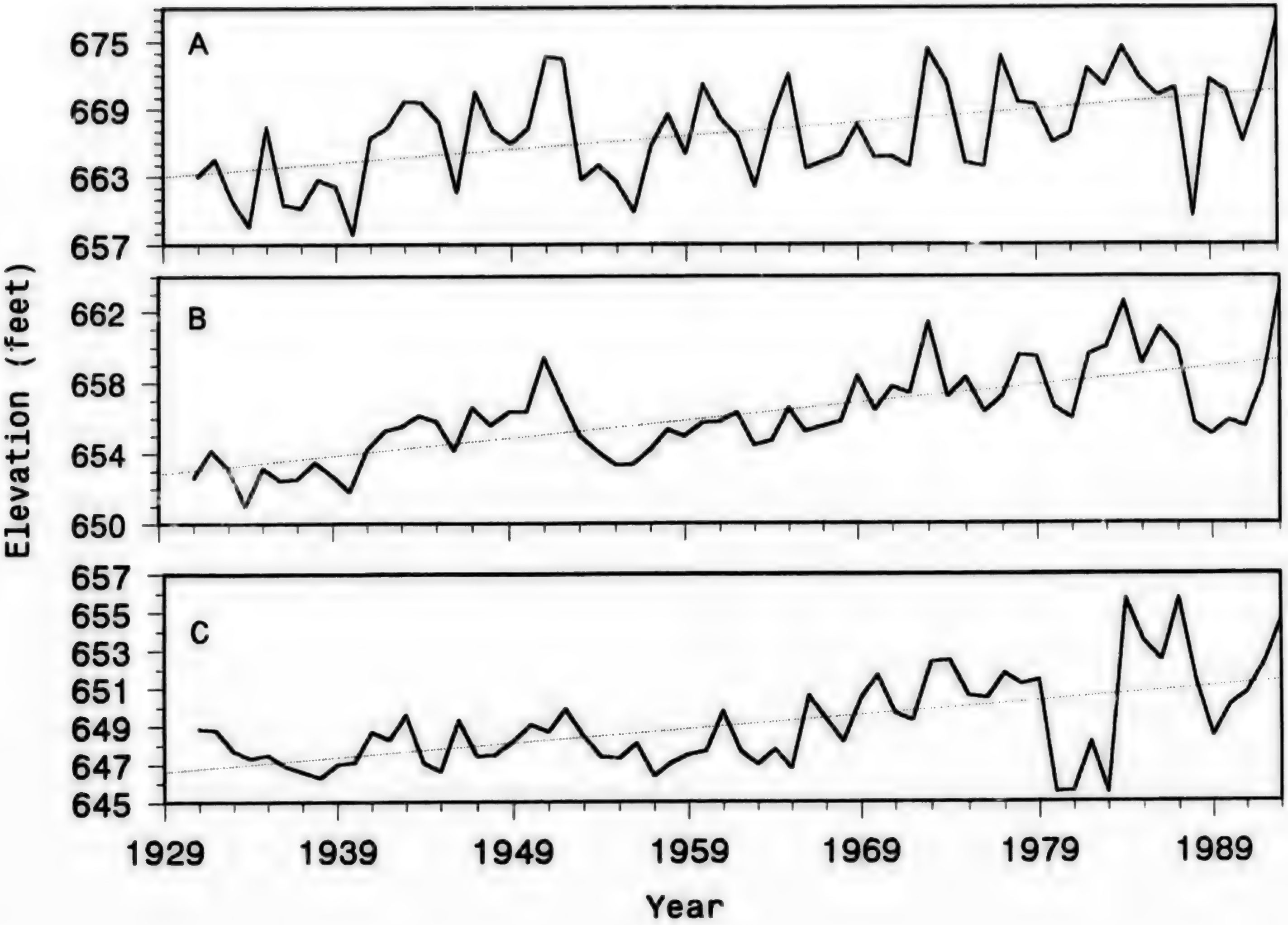

Figure 2. The maximum (A), yearly mean (B), and minimum (C) water level elevations at Waverly, Missouri, between 1931 and 1993 using dataset A.

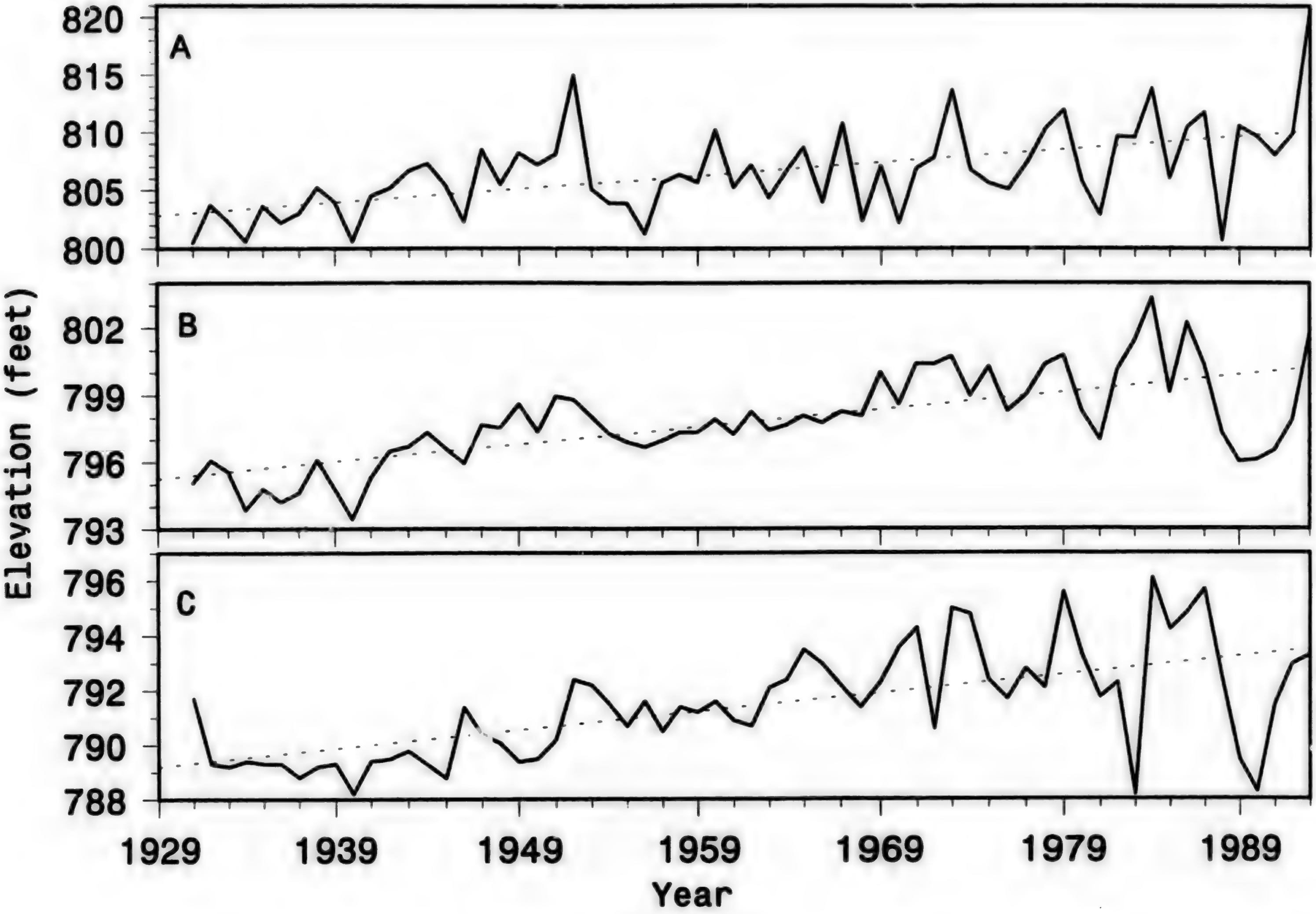

Figure 3. The maximum (A), yearly mean (B), and minimum (C) water level elevations at St. Joseph, Missouri, between 1931 and 1993 using dataset A.

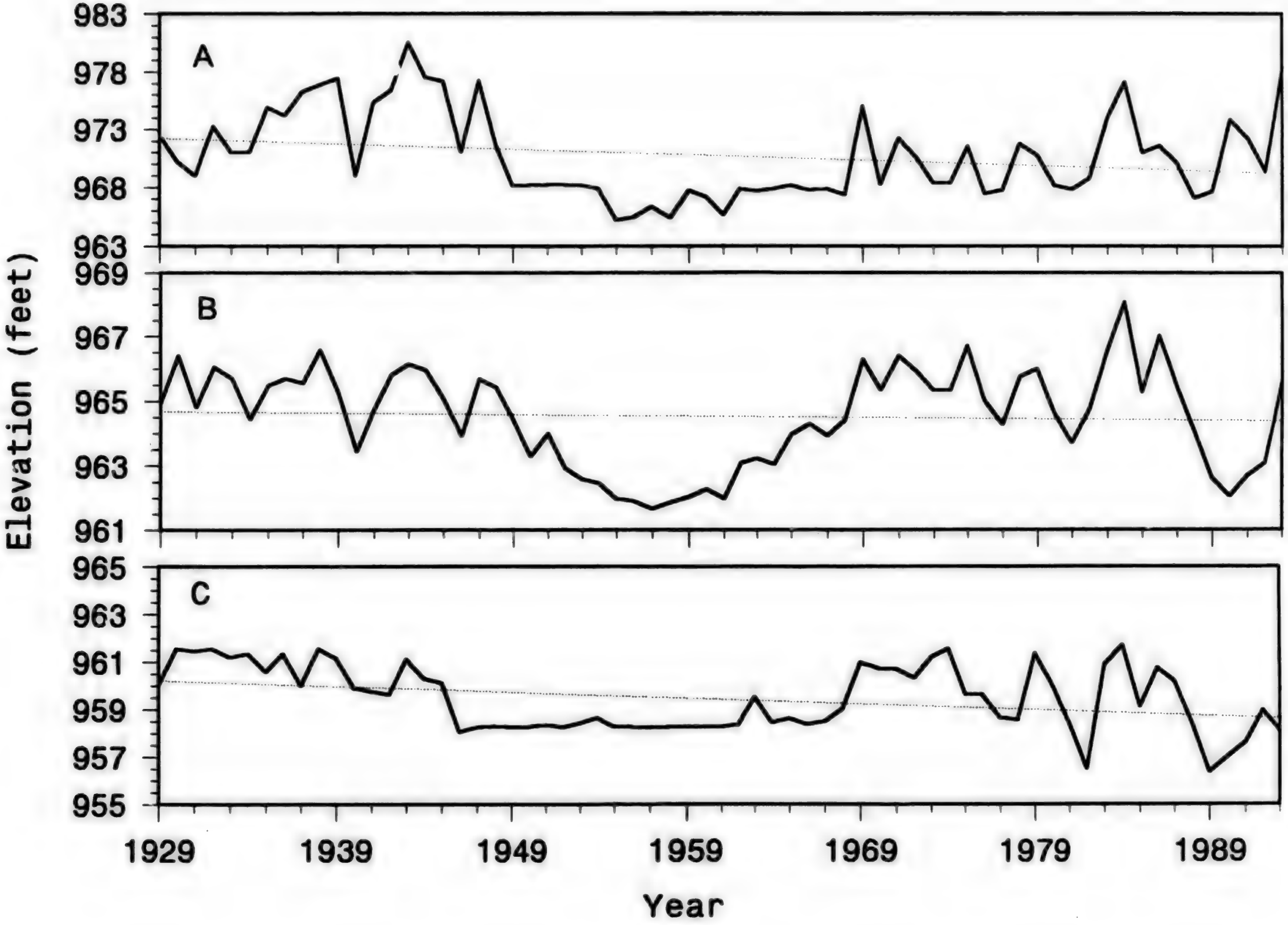

Figure 4. The maximum (A), yearly mean (B), and minimum (C) water level elevations at Omaha, Nebraska, between 1929 and 1993 using dataset A.

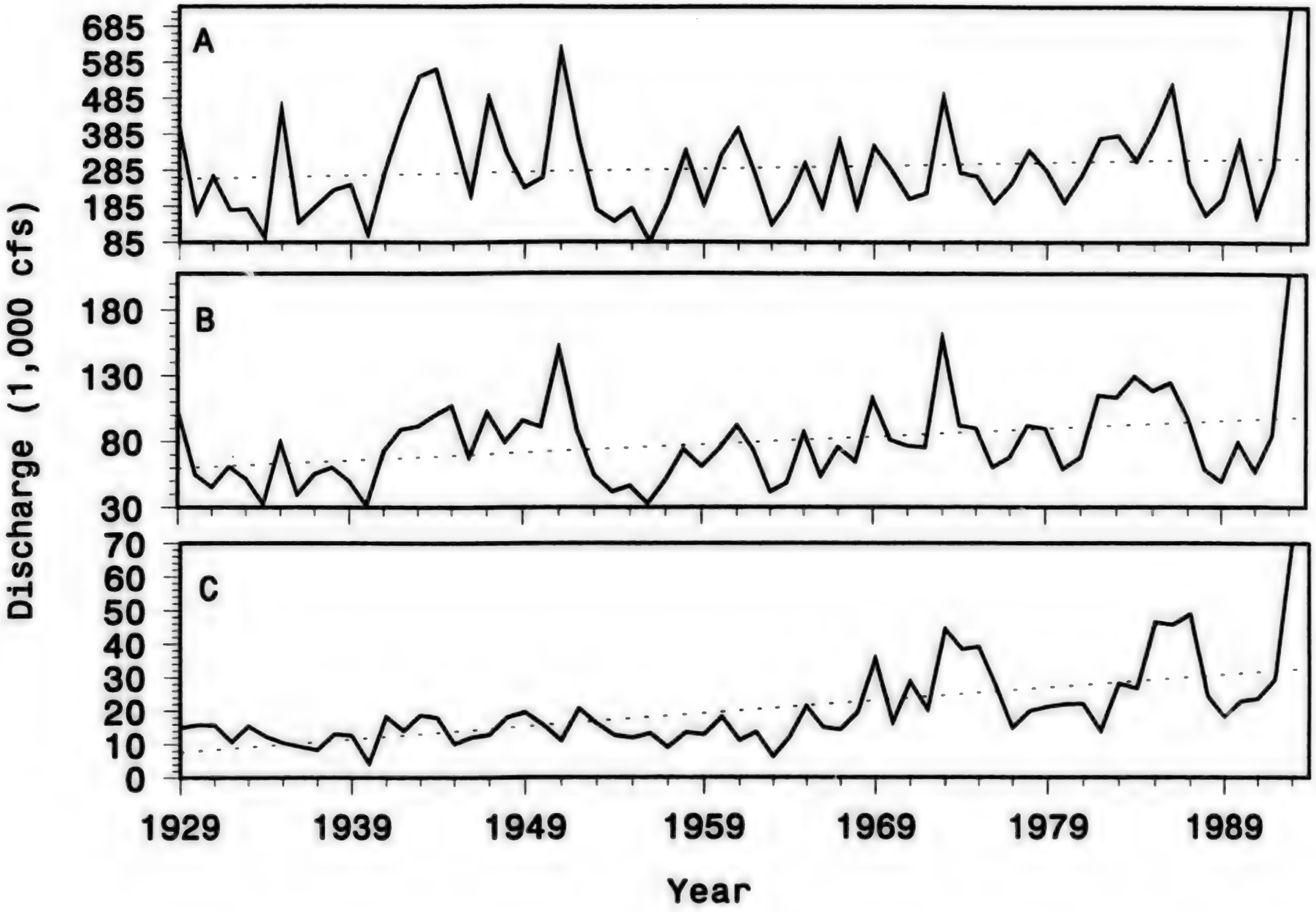

**Figure 5.** The maximum (A), yearly mean (B), and minimum (C) discharges at Hermann, Missouri between 1929 and 1993.

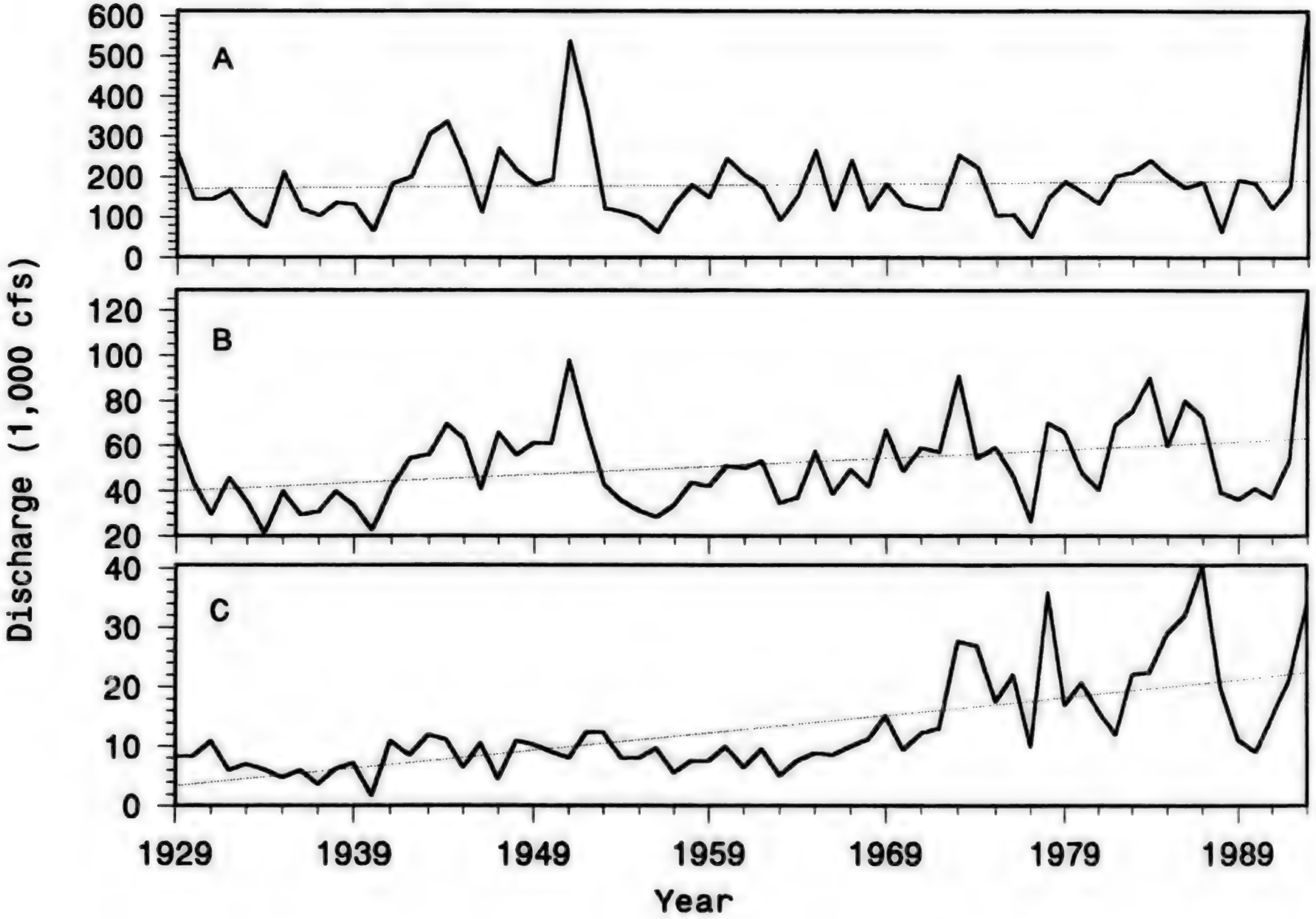

**Figure 6.** The maximum (A), yearly mean (B), and minimum (C) discharges at Waverly, Missouri between 1929 and 1993.

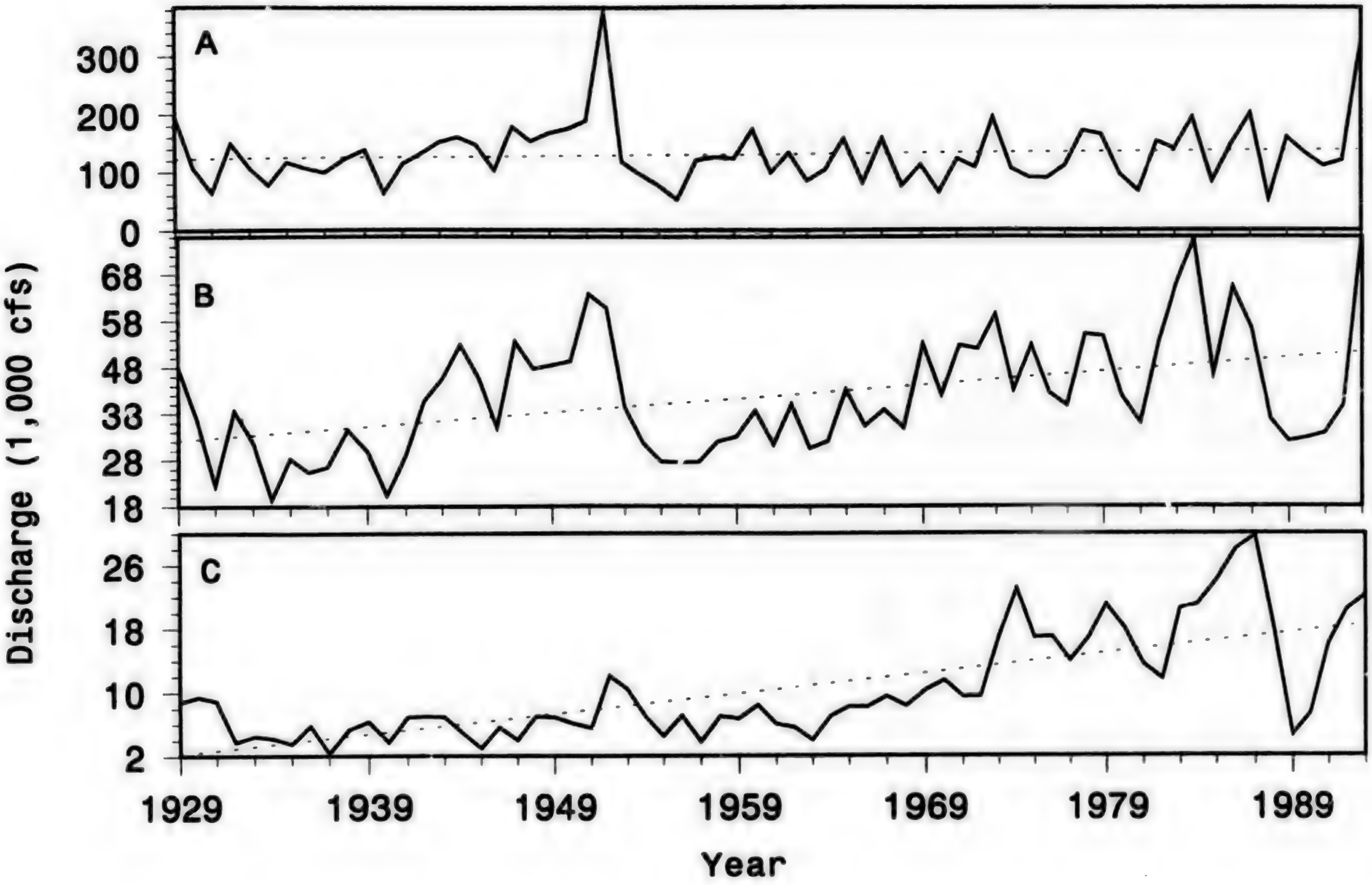

Figure 7. The maximum (A), yearly mean (B), and minimum (C) discharges at St. Joseph, Missouri between 1929 and 1993.

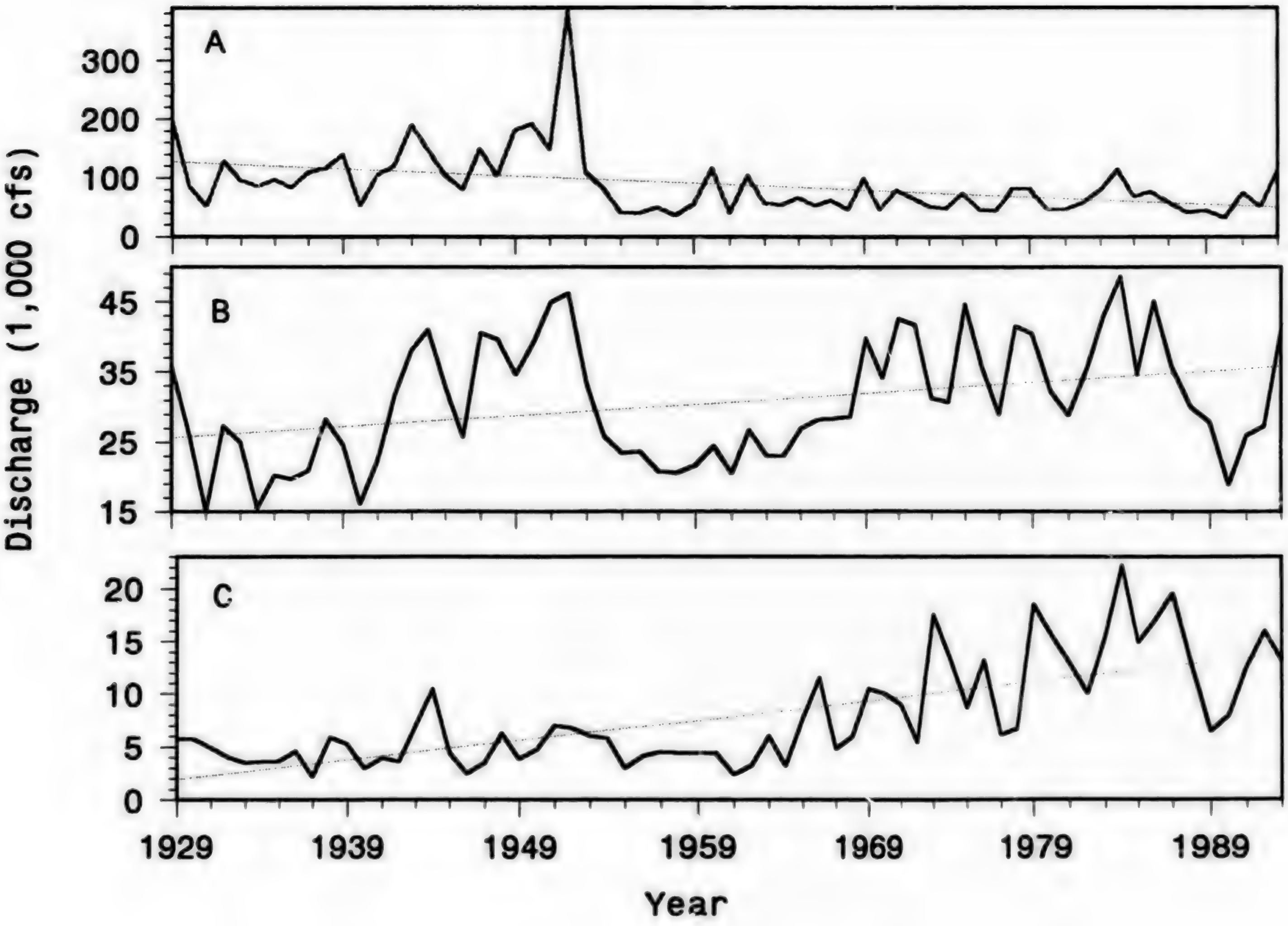

Figure 8. The maximum (A), yearly mean (B), and minimum (C) discharges at Omaha, Nebraska between 1929 and 1993.

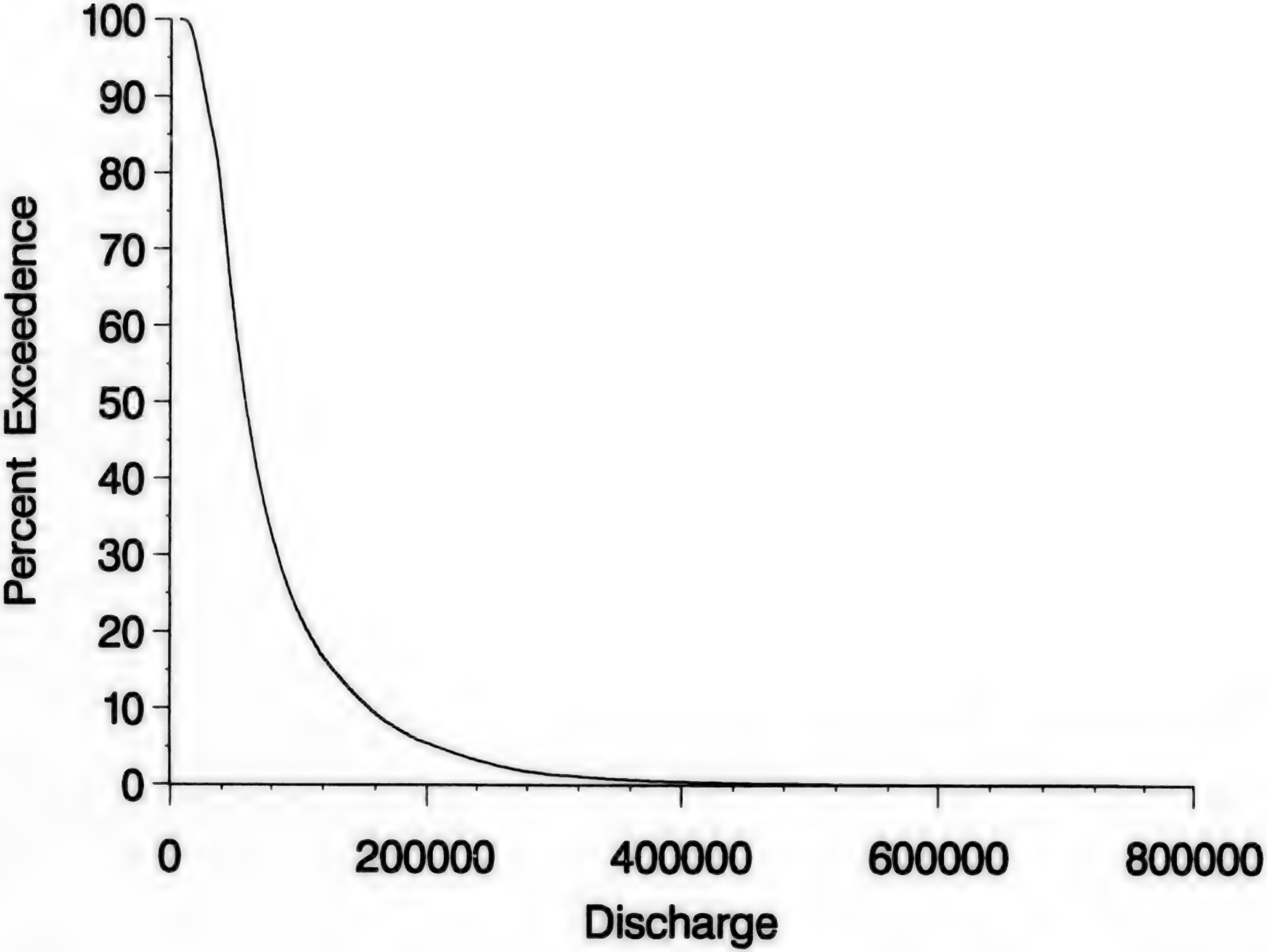

**Figure 9.** Exceedence curve for discharge based on data from 1929 through 1993 at Hermann, Missouri.

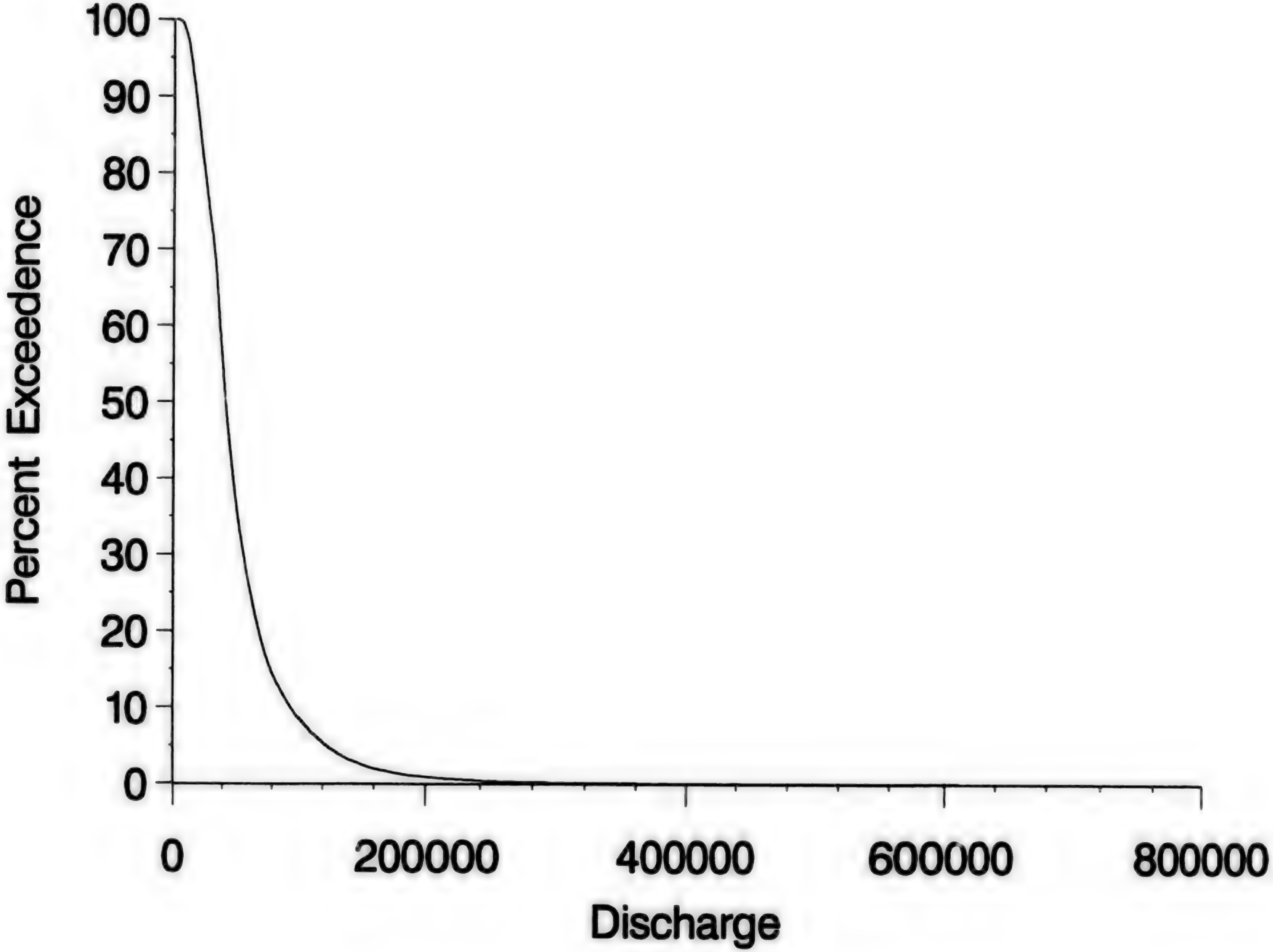

**Figure 10.** **Exceedence curve for discharge based on data from 1929 through 1993 at Waverly, Missouri.**

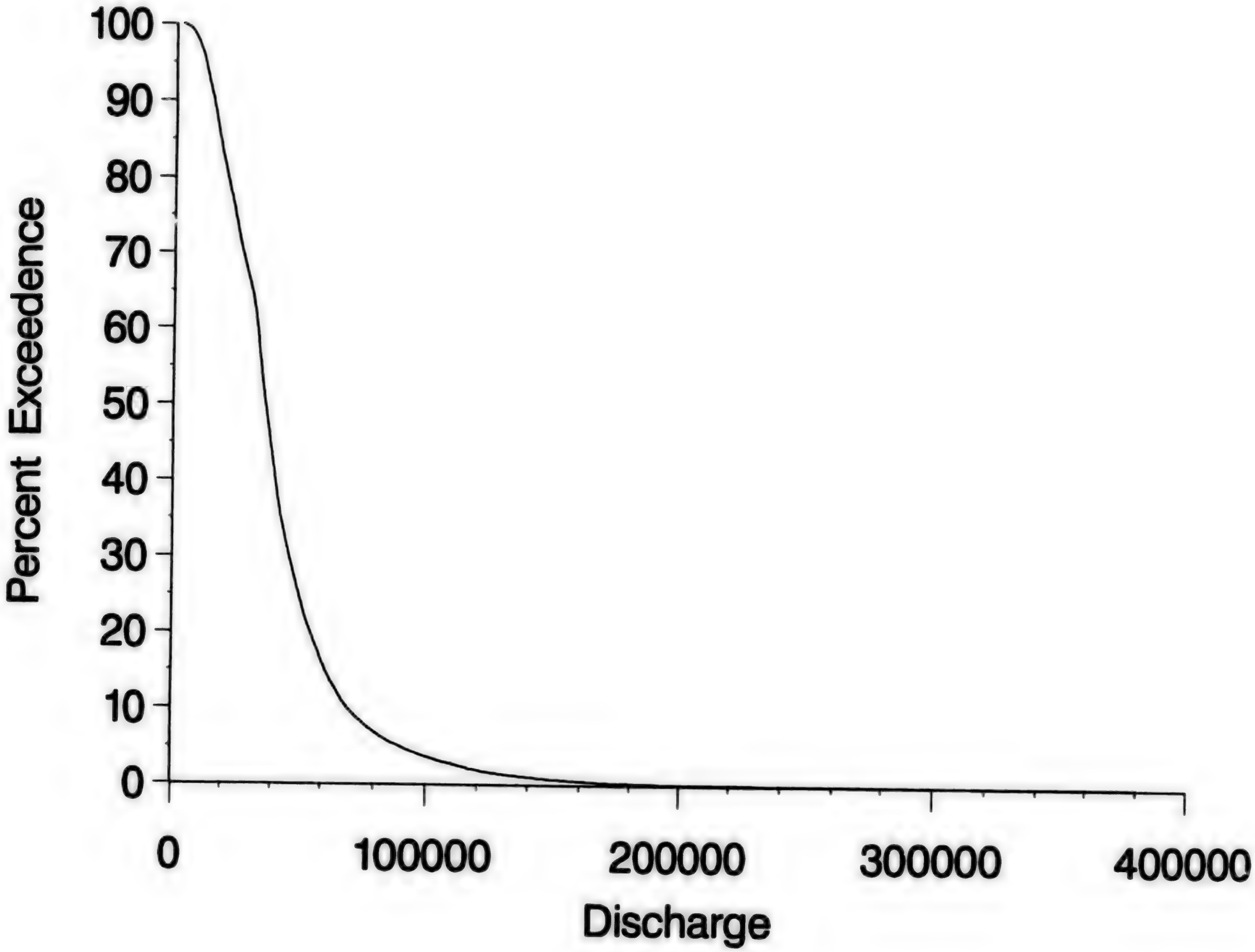

**Figure 11.** Exceedence curve for discharge based on data from 1929 through 1993 at St. Joseph, Missouri.

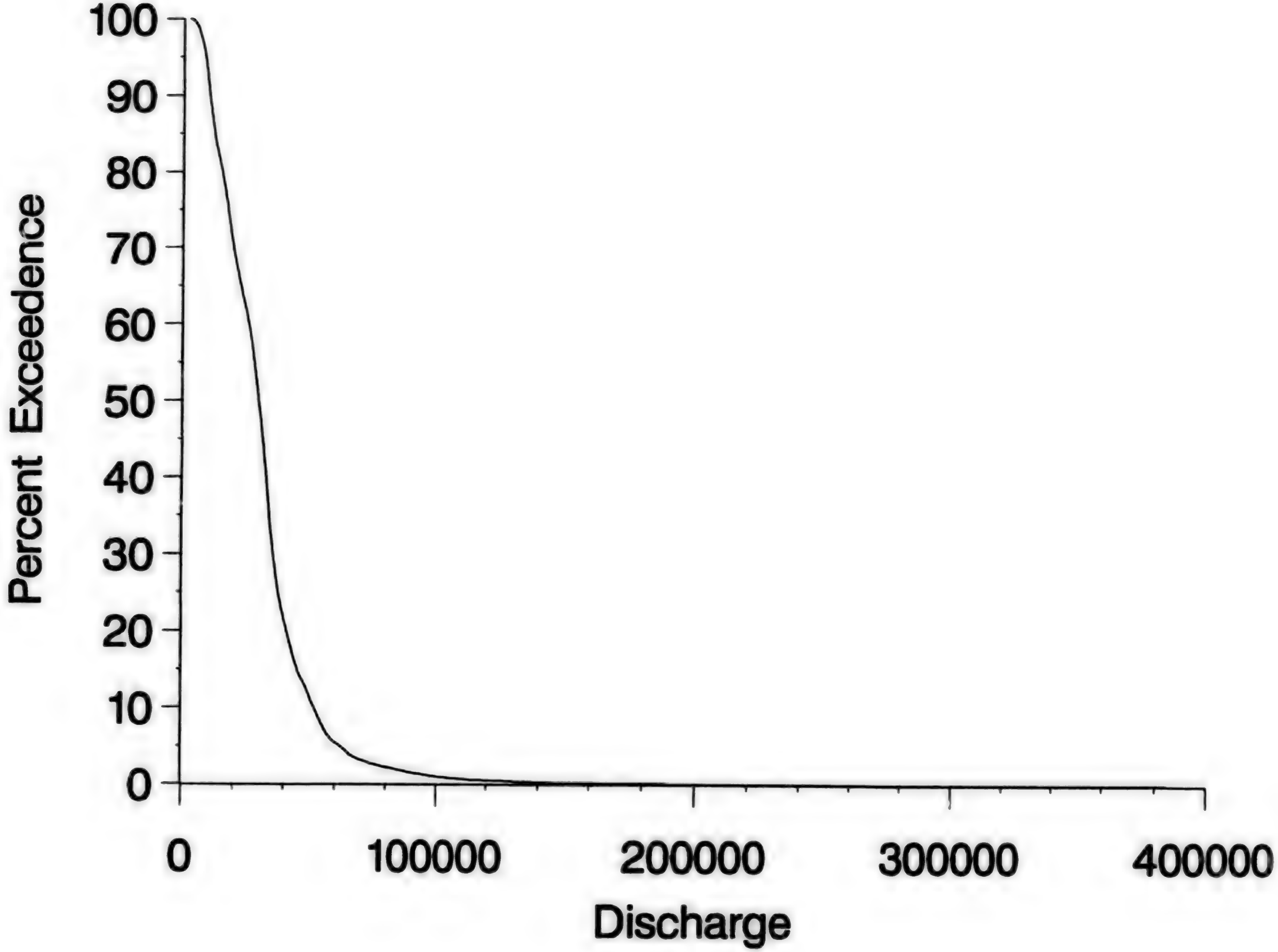

**Figure 12.** Exceedence curve for discharge based on data from 1929 through 1993 at Omaha, Nebraska.

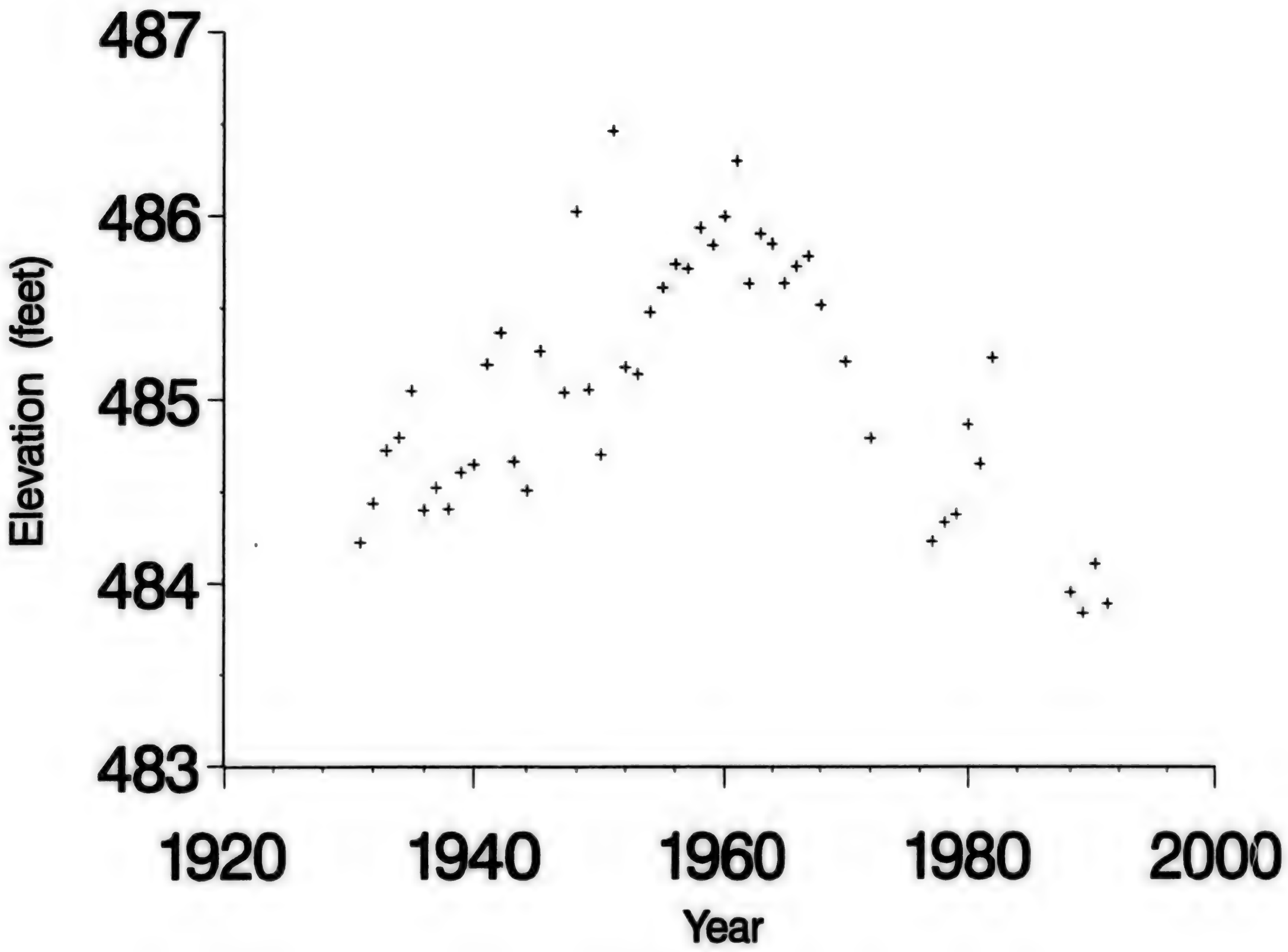

Figure 13. Predicted water level elevations at 25,000 cfs at Hermann, Missouri, using dataset B.

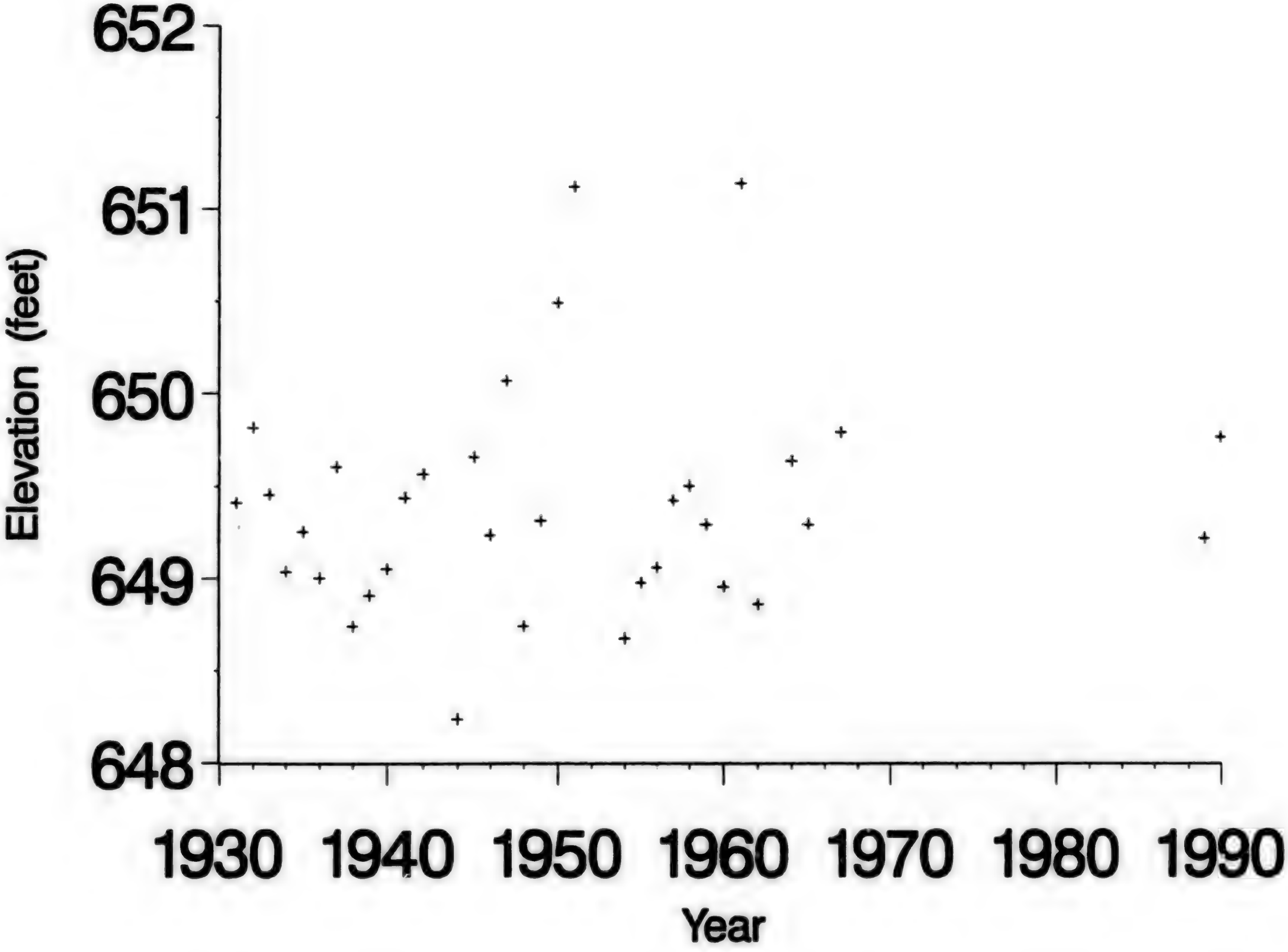

**Figure 14.** Predicted water level elevations at 12,000 cfs at Waverly, Missouri, using dataset B.

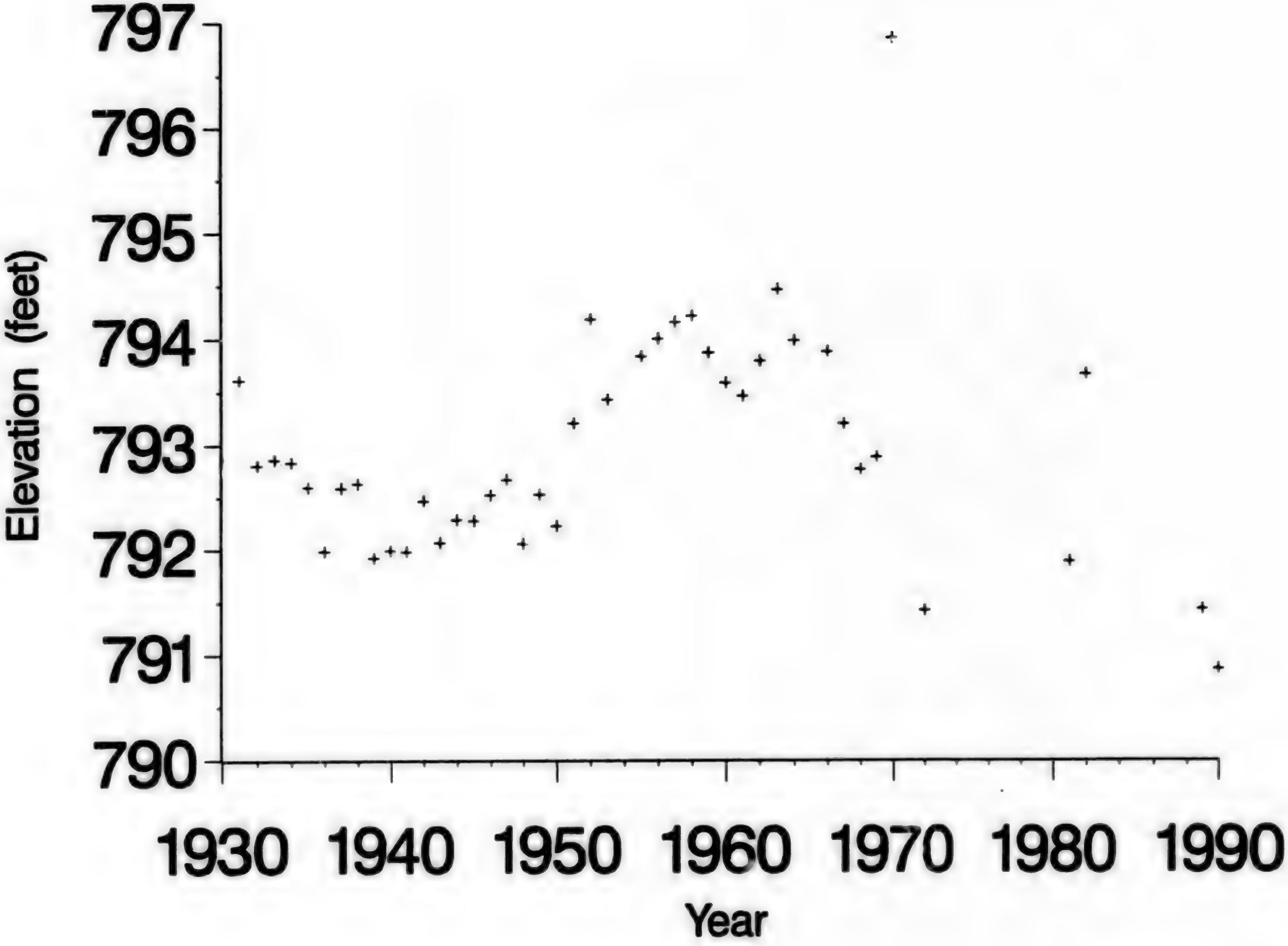

**Figure 15.** **Predicted water level elevations at 14,000 cfs at St. Joseph, Missouri, using dataset B.**

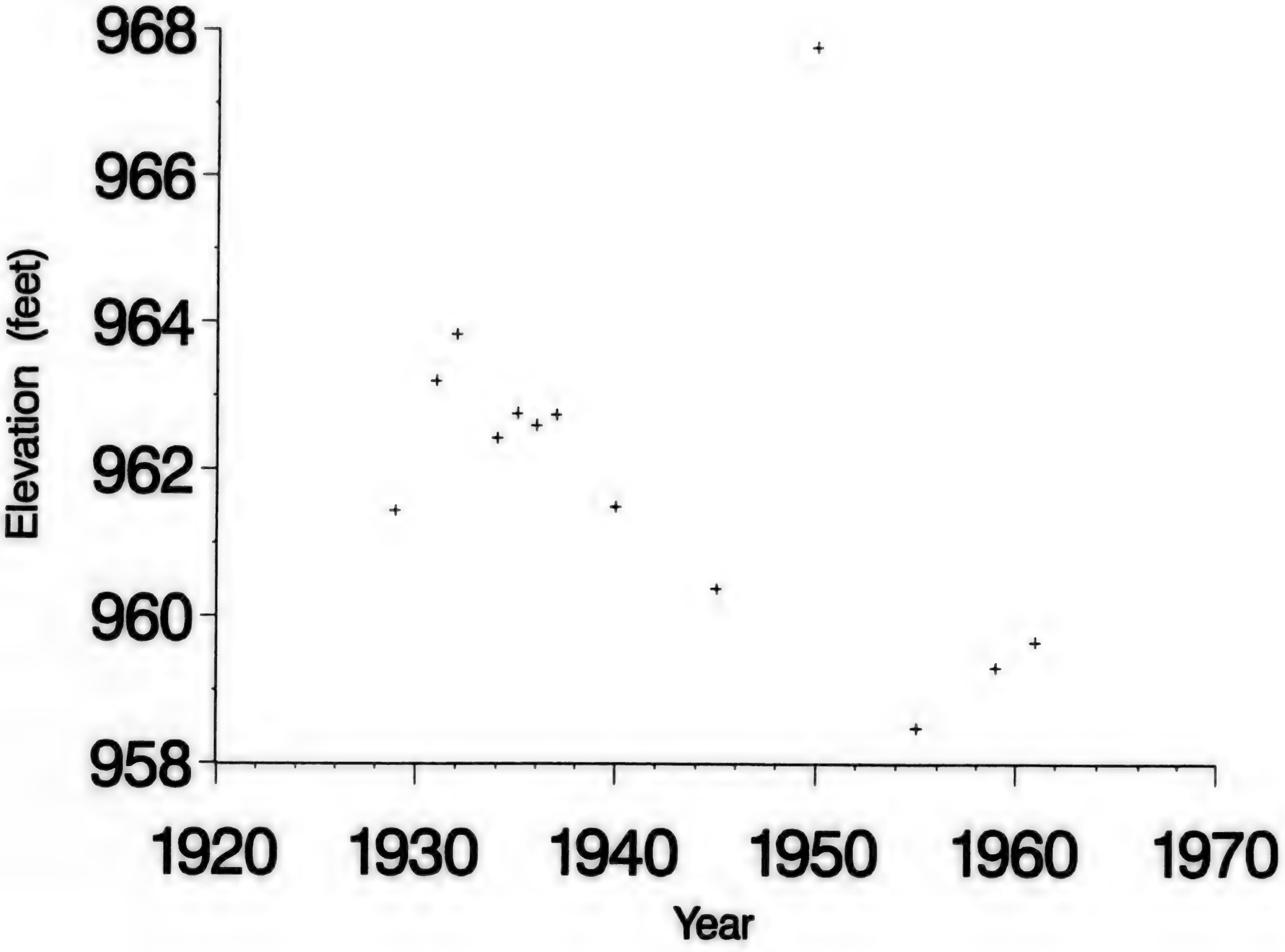

**Figure 16.** Predicted water level elevations at 8,000 cfs at Omaha, Nebraska, using dataset B.

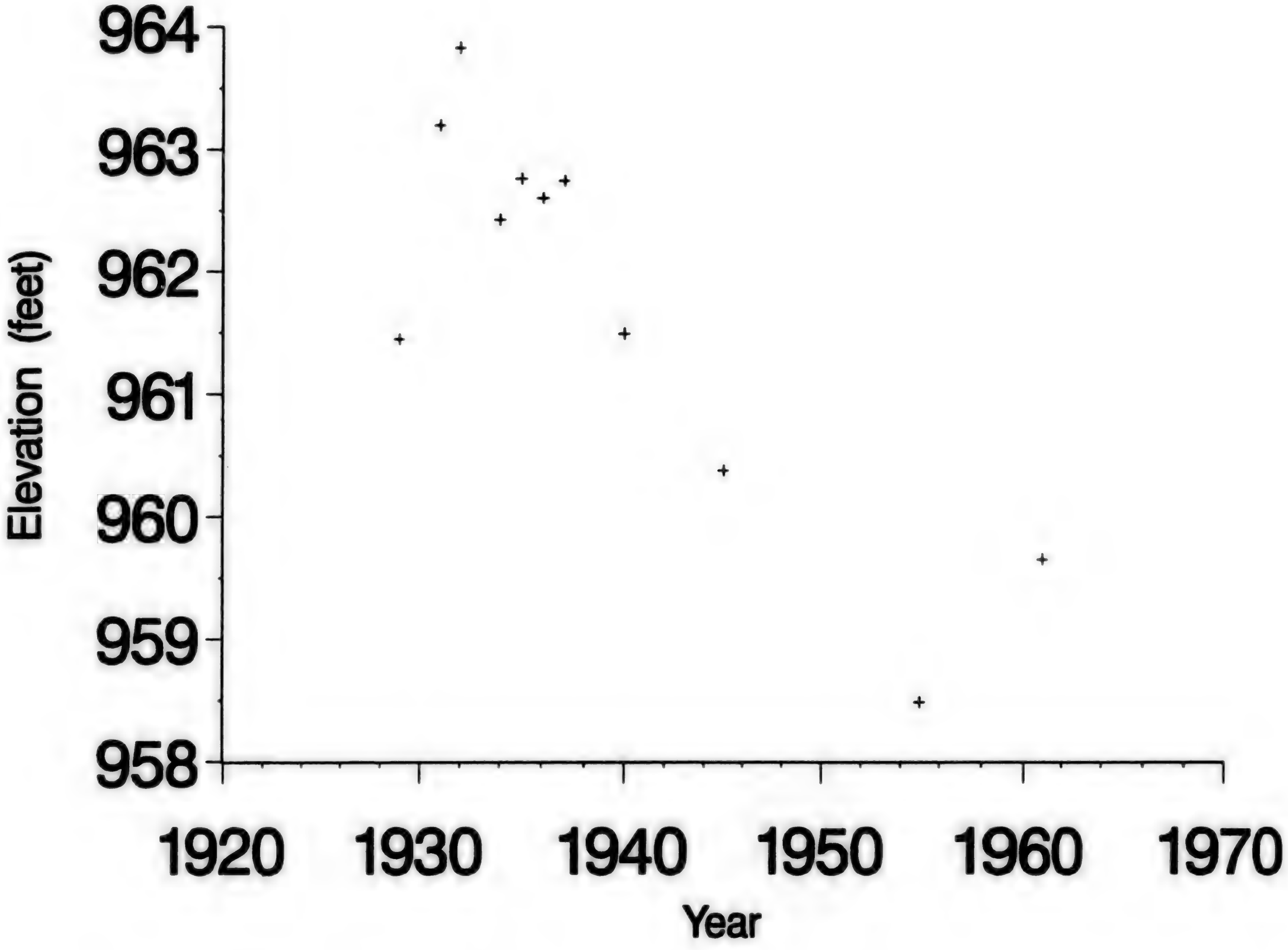

**Figure 17.** Predicted water level elevations at 8,000 cfs at Omaha, Nebraska, using dataset B only for years with R-squared values >0.90.

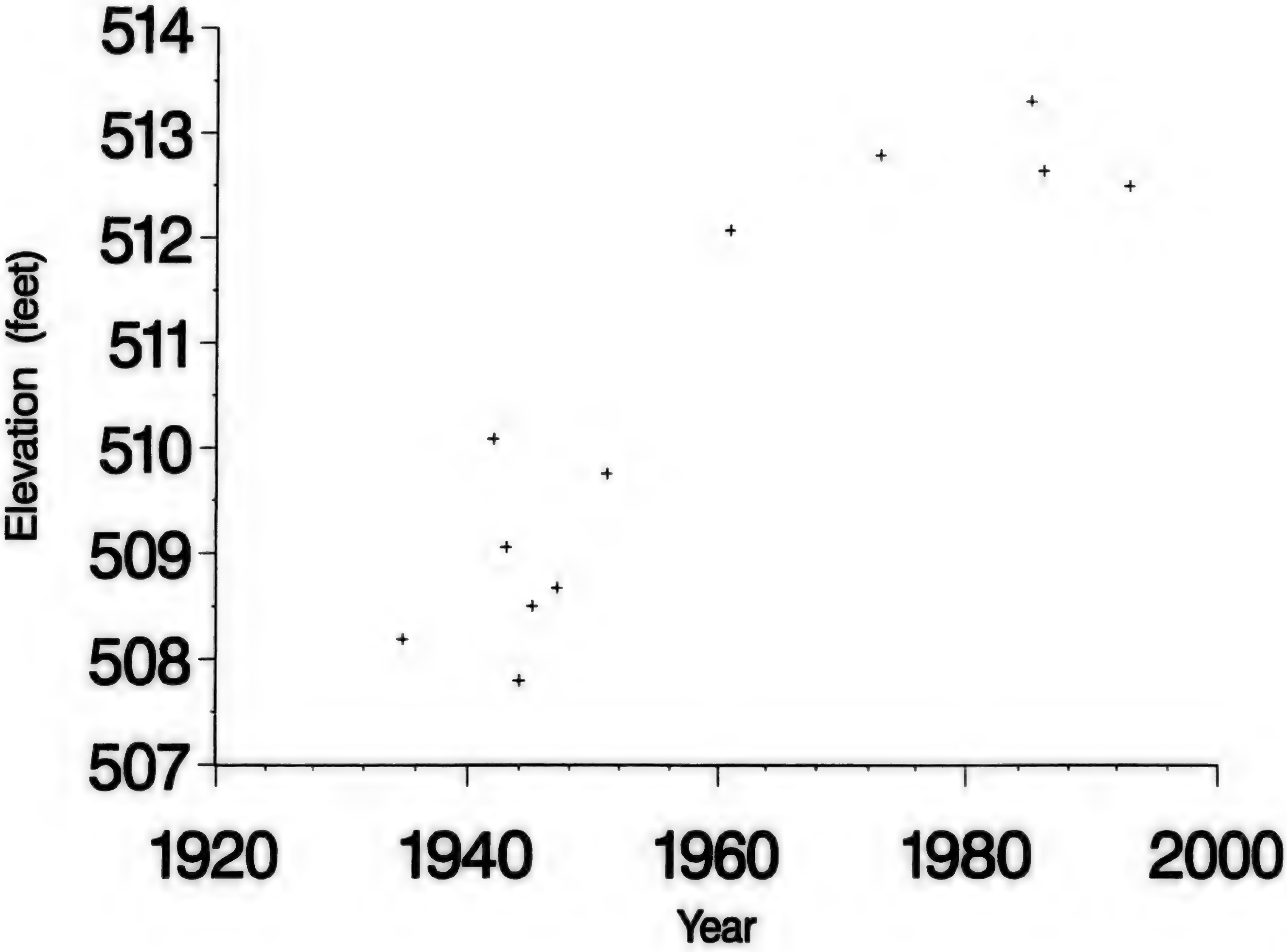

Figure 18. Predicted water level elevations at 385,000 cfs at Hermann, Missouri, using dataset B.

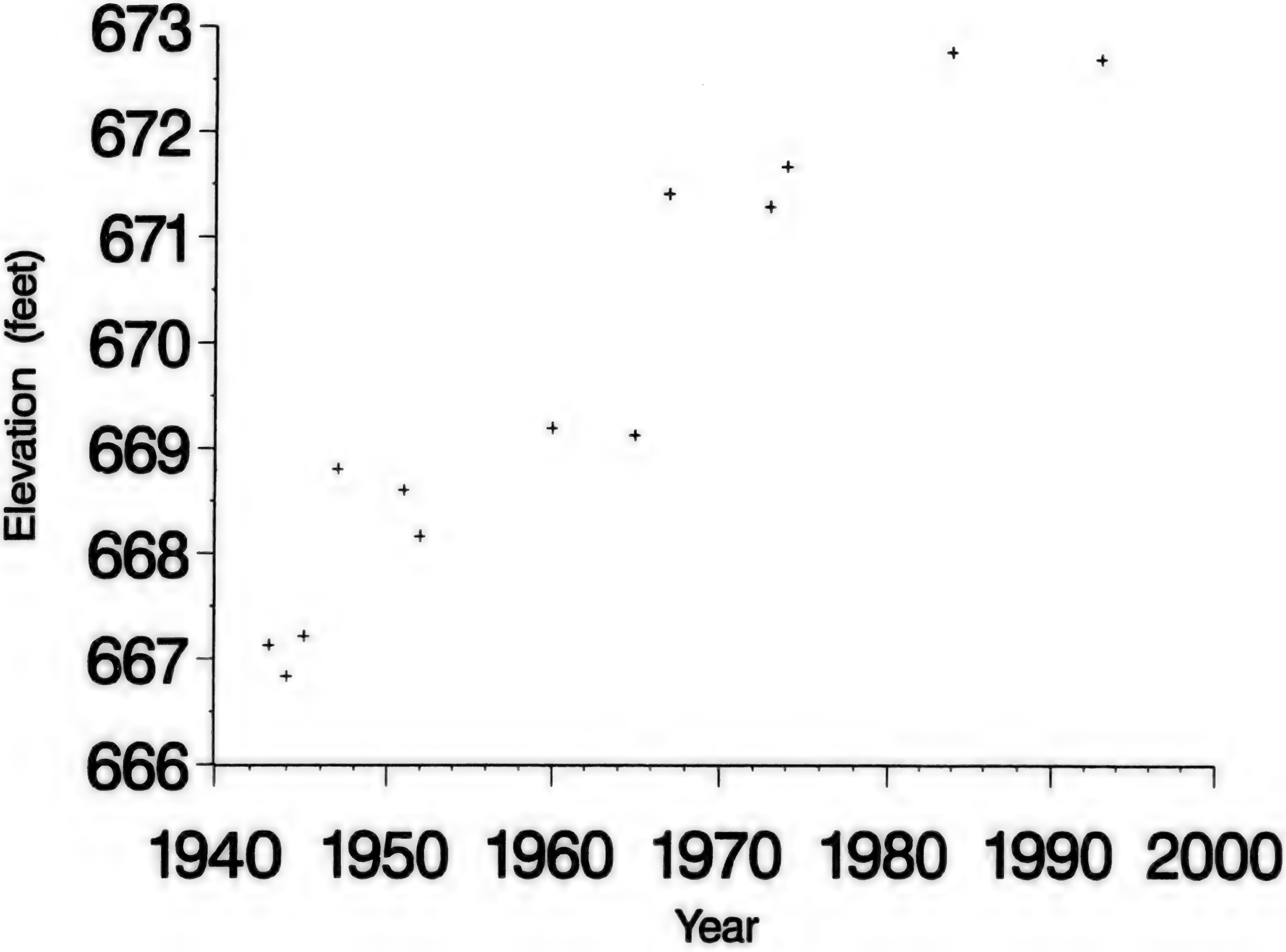

**Figure 19.** Predicted water level elevations at 220,000 cfs at Waverly, Missouri, using dataset B.

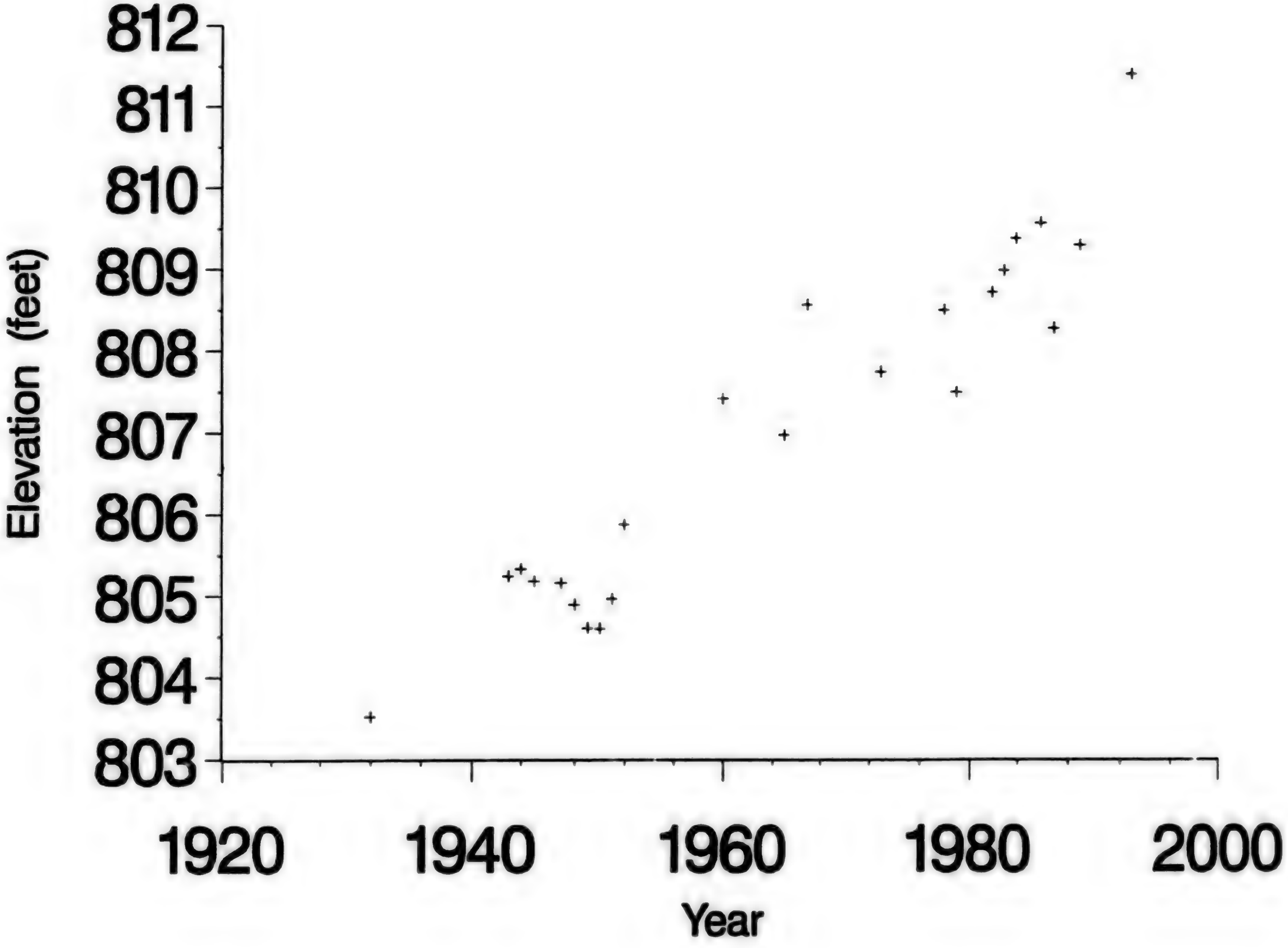

Figure 20. Predicted water level elevations at 140,000 cfs at St. Joseph, Missouri, using dataset B.

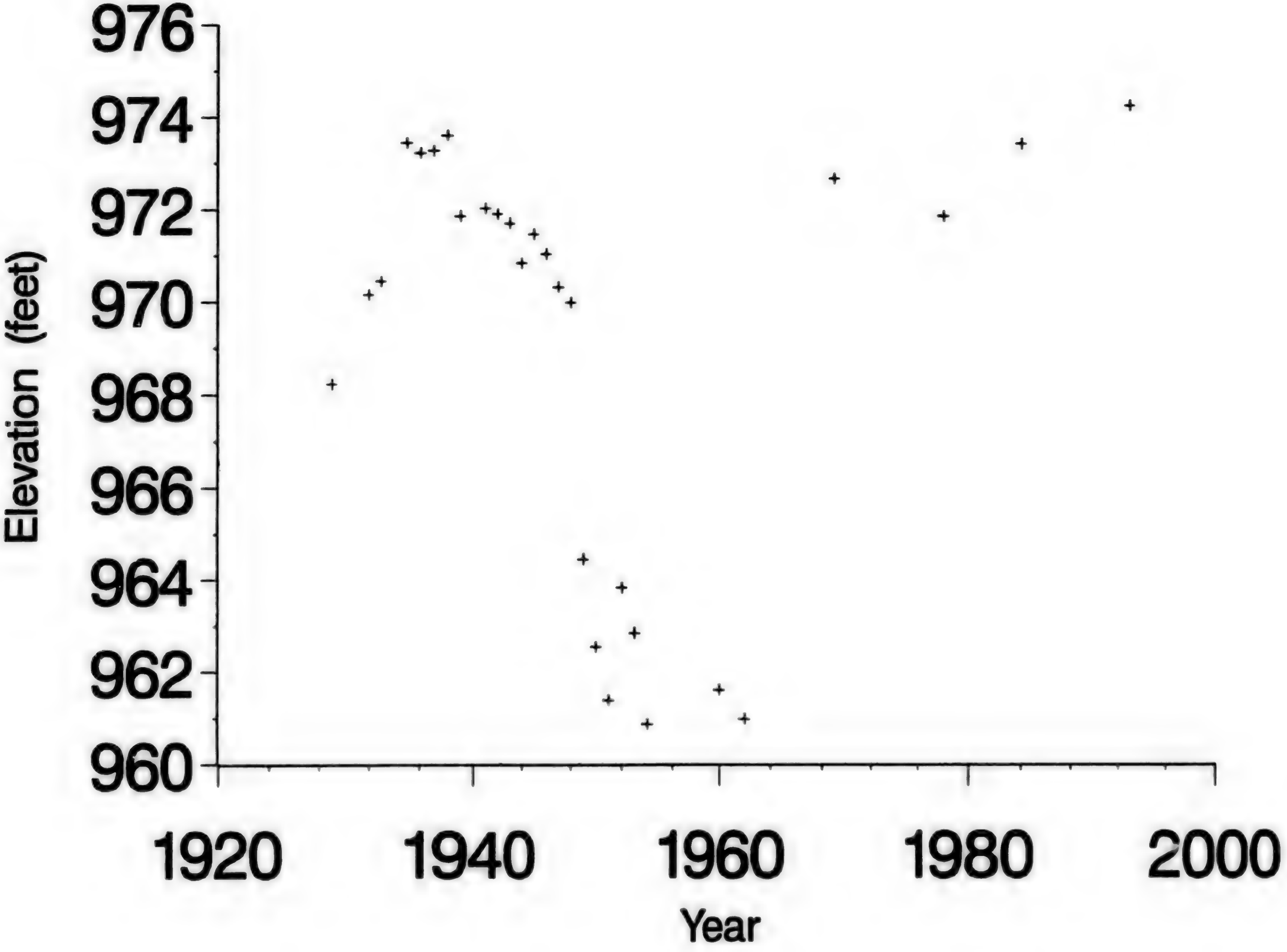

**Figure 21.** Predicted water level elevations at 80,000 cfs at Omaha, Nebraska, using dataset B.

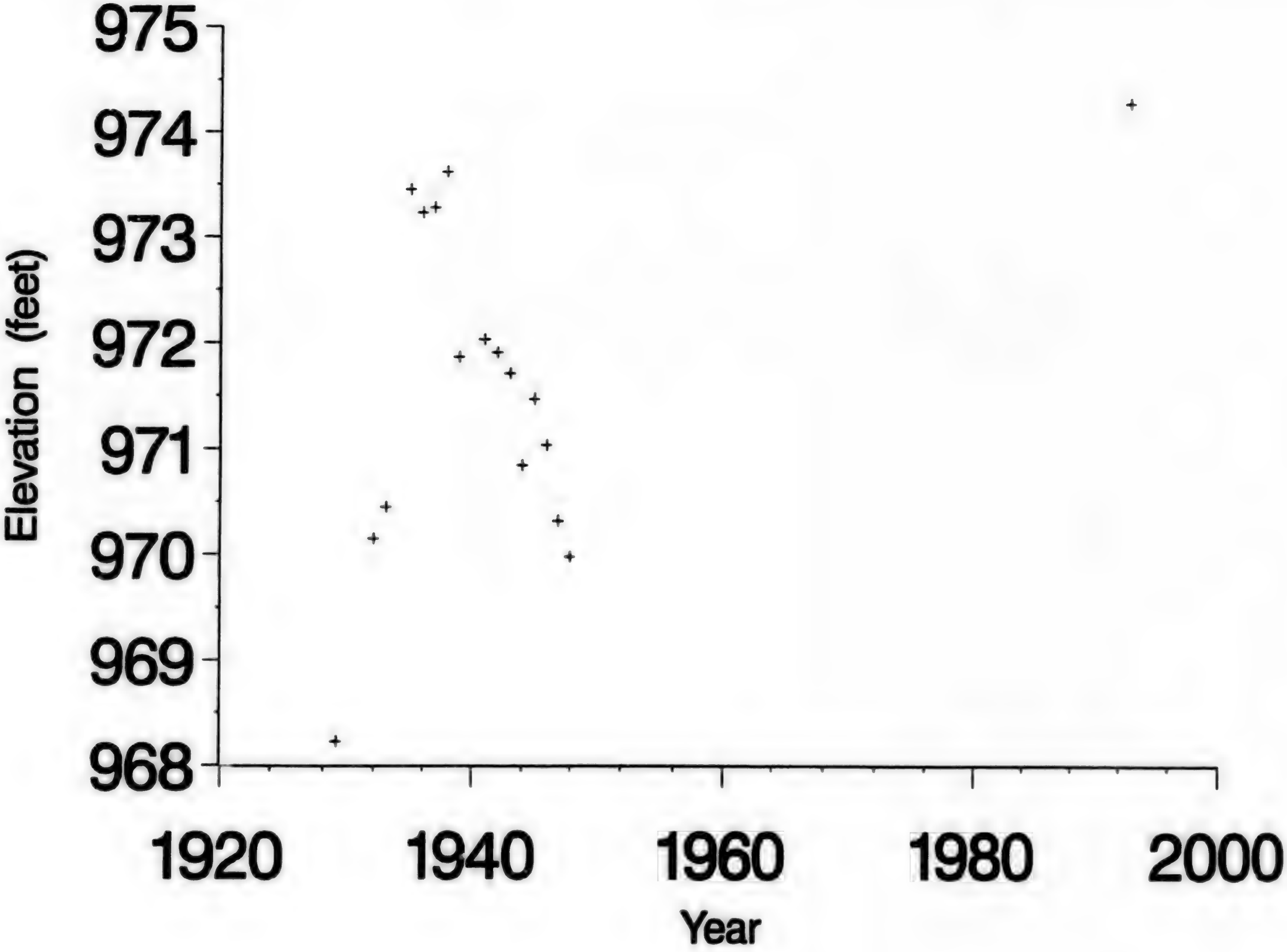

**Figure 22.** Predicted water level elevations at 80,000 cfs at Omaha, Nebraska, using dataset B only for years with R-squared values >0.90.

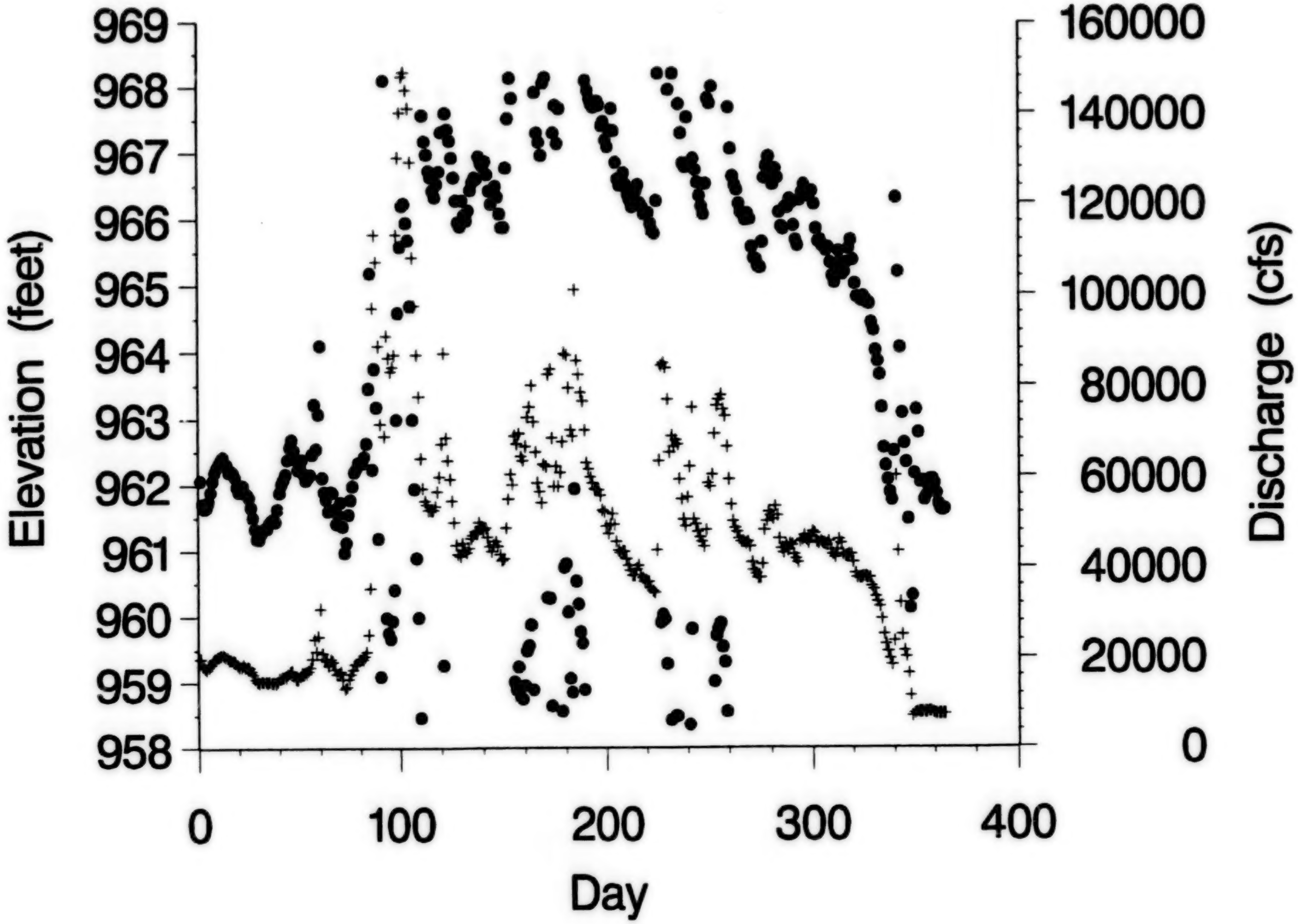

Figure 23. Plots of water levels and discharge at Omaha, Nebraska, in 1951. The R-squared value for this relationship is 0.48. Dots are elevation.

REPORT DOCUMENTATION PAGE

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13. ABSTRACT (Maximum 200 words)

Analyses of water level elevations and discharge data on the lower Missouri River were made at four stations: Hermann, Missouri, at river mile 97.9; Waverly, Missouri, at river mile 293.5; St. Joseph, Missouri, at river mile 448.2; and Omaha, Nebraska, at river mile 615.9. Data were originally collected by the U.S. Army Corps of Engineers and the U.S. Geological Survey. Analysis was performed at all four stations on data collected between 1928 and early 1994. Trends for minimum, maximum, and mean water levels and discharge are all increasing at the three downriver stations. The same trend was not found at Omaha, but the data used for that station were questionable. The relationship between discharge and elevation was calculated on a yearly basis using a third-order polynomial regression. Water level elevations increased approximately 5 feet through time at the same relatively high discharge at the three downriver stations. No such trend was obvious at these three stations during relatively low discharges.

14. SUBJECT TERMS

discharge, water level, water level elevation, water elevation, Missouri River

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20. LIMITATION OF ABSTRACT

The Long Term Resource Monitoring Program (LTRMP) for the Upper Mississippi River System was authorized under the Water Resources Development Act of 1986 as an element of the Environmental Management Program. The mission of the LTRMP is to provide river managers with information to maintain the Upper Mississippi River System as a viable large river ecosystem given its multiple-use character. The LTRMP is a cooperative effort by the National Biological Survey, the U.S. Army Corps of Engineers, and the states of Illinois, Iowa, Minnesota, Missouri, and Wisconsin.

# END

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